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FOR ENGINEERS AND CONTRACTORS CONTROLLING THE DESIGN, SPECIFICATION, INSTALLATION AND MAINTENANCE OF HEATING, VENTILATING AND AIR CONDITIONING.

HEATING & VENTILATING
AIR CONDITIONING

FOR FEBRUARY, 1939

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The illustration on this month's cover is presented through the courtesy of Crane Company, in whose research laboratories the photograph was taken. It shows an investigator examining the structure of metals through a metallographic microscope. Such a study provides the answers to many questions about the structure of metals used in the company's valves, fittings, and other products.

THIS MONTH:

HOUSING. *Reams have been written about housing the last few years, but very little about the heating engineer and his relation to the housing problem. On page 31 begins a four-page article by Charles E. Mayette, outlining the considerations which govern the planning of heating systems for multiple low cost housing projects.*

DUCTS. *In this issue, on page 15, a new series of articles is begun and having as its object the statement of the fundamental principles of air flow and its distribution through ducts. This article is the first of six which will appear each month until concluded.*

CONVECTORS. *11 diagrams showing the methods of connecting the steam piping to gravity convectors, together with a description, appear on pages 18 and 19. The article covers both convectors without a casing or covering and those with an integral casing.*

HOSPITALS. *The air conditioning of hospitals is rapidly coming to the front. On page 30 is a description of a hospital in Dallas where individual bedside control of both summer and winter air conditioning is provided. A single pull of the switch will bring either warmed winter or air cooled summer air to the patient's room.*

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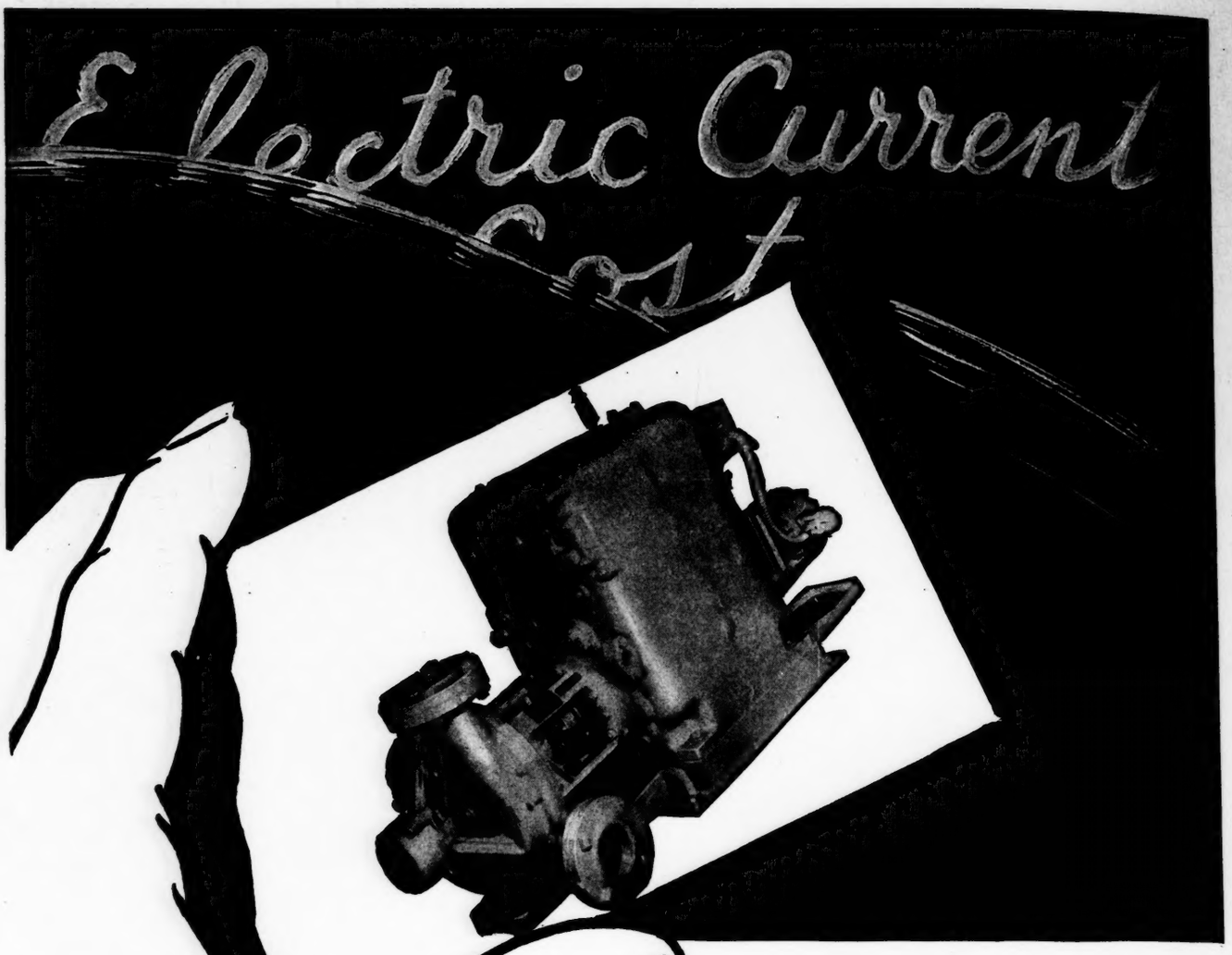

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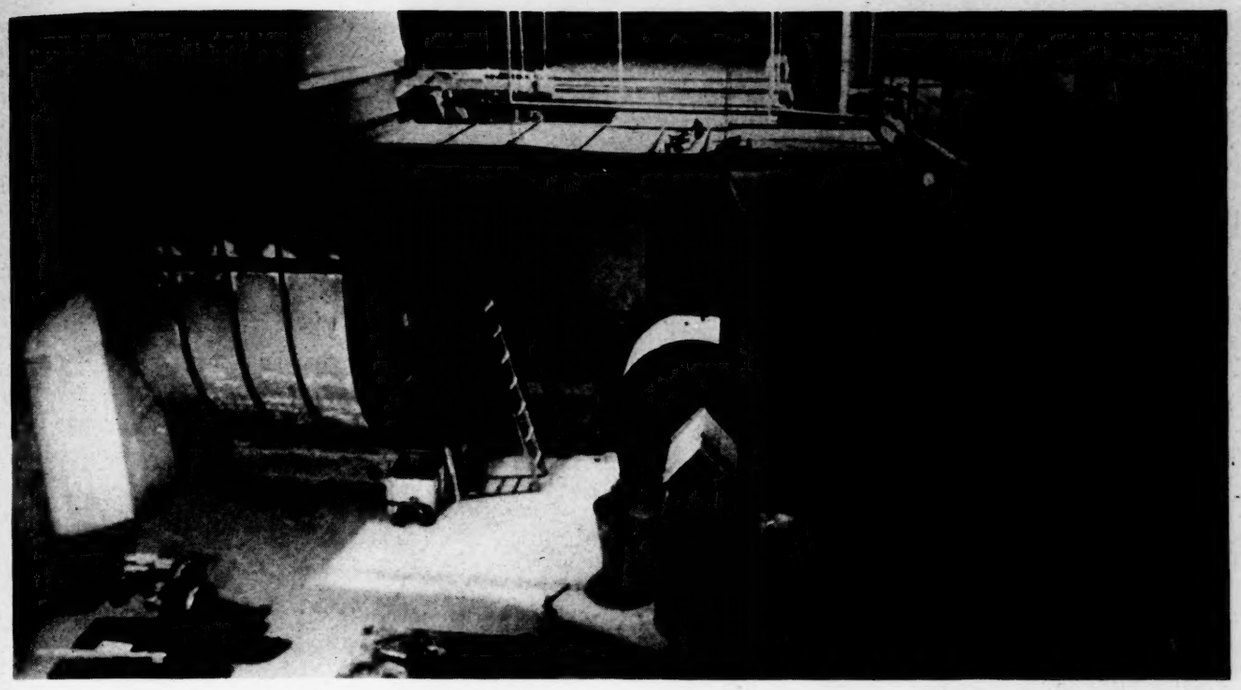

The Flow of Air and Its Distribution Through Ducts

Part 1—Frictionless Flow and Velocity Head

By J. R. ZWICKL†

IN this series of articles, based on the elementary equation for flow, correct formulas will be developed for the flow of air in ducts without and with friction. Special emphasis will be placed on the distinction between the "true" and the "apparent" values of head and head-loss.

The correct (Fritzsche) formula for friction loss in round ducts will be extended to rectangular ducts and based on this a new convenient and correct way will be shown for figuring the dimensions of equivalent round and rectangular ducts. Calculation of elbow losses will be discussed sufficiently in a somewhat new way and so will the application of turnblades.

Procedure of duct layout will be explained in detail. Fan laws will be developed from the underlying physical laws and their use for the fan selection explained in detail.

In this first article Frictionless Flow and Velocity Head will be discussed.

Flow of Air without Friction

General Equation of Flow: This subject includes the expansion of air from higher pressure to lower for the mere purpose of gaining velocity, i.e., for accelerating the air in its flow. The basic elementary equation for this type of flow is:

$$dL = V(-dP) = \frac{-dP}{m} = d\left(\frac{c^2}{2g}\right) \text{ ft.-lb. per lb.} \ldots\ldots (1)$$

where

P = absolute pressure in pounds per square foot,
dP = elementary pressure drop,
$V = 1/m$ = specific volume in cubic feet per pound,
$m = 1/V$ = density in pounds per cubic foot,
c = velocity in feet per second,
g = 32.2 feet per second per second,
$c^2/2g$ = kinetic energy in foot-pounds per pound (feet),
L = work done by or on *one pound* of air or gas during expansion or compression in foot-pounds per pound.

Equation (1) holds true for any fluid, whether liquid or gas. It means that the decrease in potential energy (energy due to pressure) is equal to the increase in kinetic energy (energy due to velocity) or vice versa.

A number of articles on air flow have appeared in various publications recently; some of these have been confusing and misleading while others have been inaccurate. This article is the first of a series of six by Doctor Zwickl, who will, in the closing parts, carry a practical problem through to its complete solution. Throughout the series the author has attempted to treat this important subject concisely and at the same time explain the logical development of the theory surrounding the subject.

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If we integrate equation (1) between the pressure limits P_1 and P_2, we get the full work done by *each* pound of the expanding fluid; this work appears as increase in its own kinetic energy:

$$L = \int_1^2 V(-dP) = \left(\frac{c_2^2 - c_1^2}{2g}\right) \text{ ft.-lb. per lb.} \quad (2)$$

The difference between liquids and gases in connection with equations (1) and (2) is only that for liquids the specific volume ($V = 1/m$) does not change during the expansion, whereas for gases V increases as the pressure drops.

The general gas law is

$$PV = P/m = RT \quad (3)$$

where T is the absolute temperature (460 + t) when t is in degrees F, and R is the gas constant, 53.34 for air. This equation, which gives the relation between pressure and volume for any temperature, can also be written as $bV = 0.753\ T$, when b is the absolute pressure in inches of mercury.

In fan work the pressure drop encountered is so small as compared to the absolute pressure of the gas that its influence on the specific volume or—what is the same—on the density of the air is practically nil (1-in. water column = 0.245% of one atmosphere). With this justified restriction we consider $V = 1/m$ as being constant and equation (2) becomes:

$$L = \frac{(P_1 - P_2)}{m} = \left(\frac{C_2^2 - C_1^2}{2g}\right) \text{ ft.-lb. per lb.} \quad (2a)$$

and if the initial velocity $c_1 = 0$, i.e., if the air is accelerated from standstill, then

$$L = V(P_1 - P_2) = \frac{P_1 - P_2}{m} = \frac{C^2}{2g} \text{ ft.-lb. per lb.} \quad (2b)$$

where $(P_1 - P_2)$ is the total pressure drop in pounds per square foot required for speeding up the air-mass from zero velocity to c feet per second velocity.

In fan work we express the pressure differences in inches of water column: 1-in. water column = 5.2 lb. per sq. ft. Thus we can write:

$$(P_1 - P_2) = 5.2h = m\left(\frac{c^2}{2g}\right) \text{ lb. per sq. ft.} \quad (4)$$

where h is the pressure difference or pressure drop in inches of water and m is the "true" air-density (in pounds per cubic foot) for the temperature and pressure which exists in the air-stream during the flow.

The term $(c^2/2g)$ is the kinetic energy contained in the mass of one pound of air, whereas $m\ (c^2/2g)$ is contained in the mass of one cubic foot of air under the conditions of the flow.

From equation (4) we can see that one and the same pressure drop produces a different velocity depending on the air-density; the larger m the smaller will be c and vice versa.

It is customary to express velocity in feet per minute as $v = 60\ c$; with this we can write:

$$h = \frac{m}{5.2}\left(\frac{c^2}{2g}\right) = m\left(\frac{c}{18.3}\right)^2 = m\left(\frac{v}{1098}\right)^2 \quad (5)$$

Dr. J. R. Zwickl, whose series on "The Flow of Air and Its Distribution Through Ducts," appears on these pages.

if the constants are all combined into one number.

This magnitude h is called the *velocity head* and means the pressure drop, expressed in inches of water, which is required for accelerating the air with the density m pounds per cubic foot from zero velocity to c feet per second velocity. From equation (5) we find

$$c = 18.3\sqrt{h/m} \text{ ft. per sec.} \quad (6)$$

or, with the velocity in feet per minute,

$$v = 1098\sqrt{h/m} \text{ ft. per min.} \quad (6a)$$

True and Apparent Velocity Head: It is to be clearly understood that in all the above equations m must be the *true* density of the air for the temperature and pressure which exist in the air-stream at flow conditions.

If this is not observed, serious errors will creep into the calculations.

The density m is influenced by the temperature and the pressure (barometer) according to the general gas law, equation (3).

We can write:

$$\frac{1}{V} = m = m_o\left(\frac{b}{b_o}\right)\left(\frac{T_o}{T}\right) \text{ lb. per cu. ft.} \quad (7)$$

where m_o is the density for a specified barometric pressure b_o and absolute temperature T_o.

In fan work we take as reference or *standard conditions* $b_o = 29.92$ in. of mercury and $t_o = 70$F. Thus $T_o = (460 + 70) = 530$F abs. For this case $m_o = (7.5/100)$ pounds per cubic foot. If we set this value of m_o into equation (5) we get:

$$h_o = \left(\frac{v}{4000}\right)^2 \text{ inches of water*} \quad (8)$$

as the velocity head at standard density. If we set m as per equation (7) into equation (5) we find

$$h = \left(\frac{b}{b_o}\right)\left(\frac{T_o}{T}\right)\left(\frac{v}{4000}\right)^2 = (m/m_o)\,h_o \quad (5a)$$

as the "true" velocity head expressed in terms of $h_o = (v/4000)^2$. This we may call the *apparent-velocity head*, which must be corrected for the true density m, that is, for pressure and temperature in order to get the true velocity head h. When making this correction it is well to remember that the velocity head varies linearly with the air-density; the greater the density the larger the velocity head.

The velocity head h as given in equations (5) and (5a) is the pressure drop required for creating the velocity v feet per minute. Conversely, if we reduce this velocity to zero we should regain this pressure. This is the case when the opening of the Pitot tube is held directly against the air-stream; the moving air particles impinge against the stagnant air in front of the opening and produce there a pressure equal to the velocity head h. This fact is utilized for measuring h, from which we can figure the velocity either through equation (5a) or (6a). Knowing the velocity, we can compute the air volume handled by the fan or passing through a duct or nozzle.

*In order to simplify the formulas in all equations 4000 is used instead of the more correct 4005, since for practical purposes both give the same results.

Air Horsepower: For driving the air through the ducts, heaters, coolers, and filters, fans or blowers are used. These can be considered as pressure generators which create the required total pressure h_t (inches of water) of which h inches are used up in the fan for accelerating the air to the outlet velocity v per minute and h_s inches are left over as static pressure for driving the air through the resistance of the system connected to the fan, such as friction in the ducts and apparatus. Thus the total net pressure produced by the blower is: $h_t = (h + h_s)$ in. of water or

$$(P_2 - P_1) = 5.2\ h_t = 5.2\ (h + h_s)\ \text{lb. per sq. ft.}$$

Each pound of air, when moved against this pressure, consumes the work:

$$L = \int_1^2 V dP = V(P_2 - P_1)$$
$$= 5.2V(h + h_s)\ \text{ft.-lb. per lb} \ldots\ldots\ldots\ldots\ldots (9)$$

If the fan handles the amount $G = Qm = Q/V$ pounds per minute, then the work done by the fan on this amount of air will be:

$$GL = Q\ (P_2 - P_1) = 5.2Q\ (h + h_s)\ \text{ft.-lb. per min} \ldots\ldots (10)$$

where G = quantity of air in pounds per minute and Q is the volume of air handled in cubic feet per minute, or

$$N = \frac{5.2\ Q\ (h + h_s)}{33000} = \frac{Q\ (h + h_s)}{6350}\ \text{horsepower} \ldots\ldots (11)$$

where N is termed the air-horsepower.

According to equations (10) and (11) the density of the air has no direct bearing on the work to be done by the fan. This is true inasmuch as this work of compression is fixed by the air-volume and the pressure against which this air-volume is driven. Indirectly, however, the air-density comes into the picture, since the velocity head h as well as the static head h_s increase linearly with the air-density. The same volume of air but with a greater density, when driven through the same system, requires more power in the ratio of the air-densities. This can be seen clearly, if in equation (10) we express h (and also h_s, as will be seen later) by means of equation (5a).

The brake horsepower required for driving the fan is naturally larger than N given by equation (11). The air has to move through the fan and thus must overcome the internal frictional resistance of the fan itself. This means that the fan has to produce an additional pressure (internal static pressure) which is consumed in the fan. The viscosity of the air causes a drag on the fan-wheel; the transformation of velocity into pressure is less than 100% efficient; these and other factors mean additional power, which must be supplied to the fan besides that amount N which is passed on to the air. We can write:

$$N_b = \frac{N}{e_t} \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

where e_t is the total efficiency of the fan, based on the $(h + h_s) = h_t$ total pressure.

Quite often we find that only the static head h_s is used for figuring the air-horsepower. In doing so, quite naturally, we get only the static air horsepower:

$$N_s = \frac{Q\ h_s}{6350} \ldots\ldots\ldots\ldots\ldots\ldots (13)$$

And from this we get the brake-horsepower as

$$N_b = \frac{N_s}{e_s} \ldots\ldots\ldots\ldots\ldots\ldots (14)$$

where e_s is called the *static efficiency.*

Working with formula (14) can easily lead to errors, because as the fan approaches the condition of "free delivery," the numerical value of (h_s) approaches zero and so does e_s and at free delivery the formula becomes indefinite: $N_b = 0/0$.

The second part of Doctor Zwickl's series will appear in the March issue.

Waste Heat Utilization from Gas Engines

THE utilization of waste heat in the production of power with gas engines is a field which has not been adequately developed in most sections, says the Gas Engine Power Committee of the American Gas Association in its 1938 report.

In the operation of natural gas engines, a relatively small percentage of the heat value for the fuel consumed is utilized in useful work. The average natural gas engine has a thermal efficiency, in operation, of approximately 25%. The remaining heat is dissipated in jacket cooling water, radiation, friction, and exhaust gases.

The heat in the engine jacket water and exhaust gases represents nearly 65% of the total heat value of the fuel. This may be reclaimed, in a large measure, by use of heat exchangers for jacket water cooling and by further water jacketing of the exhaust lines from the engines.

The engine jacket water represents only a minor source of auxiliary heating due to the necessity of maintaining a low temperature differential (not to exceed 20F), in the engine itself with maximum jacket water temperature of not over 165 to 170F. Consequently, if higher temperatures are desired, these must be obtained by further heating, such as means of additional jacketing of the exhaust lines.

To illustrate, assume the maximum temperature of the jacket water leaving the engine is 170F. By water jacketing of the exhaust line, this temperature may be readily raised to 185F, without restricting the flow of water through the engine.

It has been found that although it is possible to reclaim "waste heat" from an internal combustion engine to the extent of 90%, it usually is practicable to reclaim only from 50% to 60% of the heat. To obtain 90% recovery nearly three times the heating surface is required as would be used to reclaim 50% of the waste heat. The expense of the additional and more elaborate heat exchangers and water jacketing to recover 90% of the waste heat in most cases would be unwarranted economically in consideration of the low gas rates available for direct heating of water wherever gas engine operation would prove an economical source of power.

Steam Piping Connections

WHERE gravity convectors of any type are used on steam heating systems they must be so connected to the piping that they will themselves operate as intended and will also not interfere with the proper functioning of any other steam-consuming equipment which may be connected to the system. It is also essential that adequate attention be paid to arrangements for securing proper and prompt drainage of condensate and that good fitting practice in pipe arrangement be carefully followed. When piping is well and carefully done gravity convectors can be used successfully on either one- or two-pipe systems.

While gravity convectors are available on the market in a wide variety of designs and of several materials they are usually so arranged that the "sectional" idea is present in order to permit ready assembly into operating units of desired capacity. So also are the pipe openings placed where several arrangements of convectors are possible. These two features lend flexibility to the piping possibilities with gravity convectors and offset to some extent a tendency toward rigidity of requirements where convectors are recessed in walls or placed in tight-fitting cabinets.

For purposes of illustration only, a single sketch showing uniform locations of the pipe openings to convectors is used in the accompanying drawings, which are schematic only and not to scale in any direction. They are intended to illustrate what may be called typical piping connections which have been found useful and by no means show all the possible piping connections or all of those which are found in field installations. However, they are sufficiently inclusive so that most of the situations met with can be recognized as being a case of one of these typical hookups.

Although convectors can be used without a casing or covering for directing the air flow over them and, although with some designs the casing is built as an integral part of the convector, it is desirable for clarity of presentation to illustrate some piping connections without any casing as in Fig. 1.

Fig. 1a shows a convector attached to a one-pipe steam system. It is essential that the convector be pitched as shown in order that the condensate may escape through the steam supply pipe. The air valve arrangement shown is one in common use. Various two-pipe arrangements are shown in Figs. 1b to 1e. Of these the one most frequently used is perhaps that of Fig. 1c. This arrangement is especially compact and permits a separately built cover or cabinet being inserted over the installed convector without disturbing the piping (see Fig. 2c). The fittings and connections can be reached readily, but frequently the space requirements make necessary a special design of fittings and accessories and special hand tools with which to install them.

Figs. 2a to 2c show casings or covers or cabinets over the convectors and illustrate the relation between the piping arrangement and those necessary parts of the completed installation. In Figs. 2b and 2d it will be noted that the piping must pass through the casing —an arrangement frequently difficult to work out. In

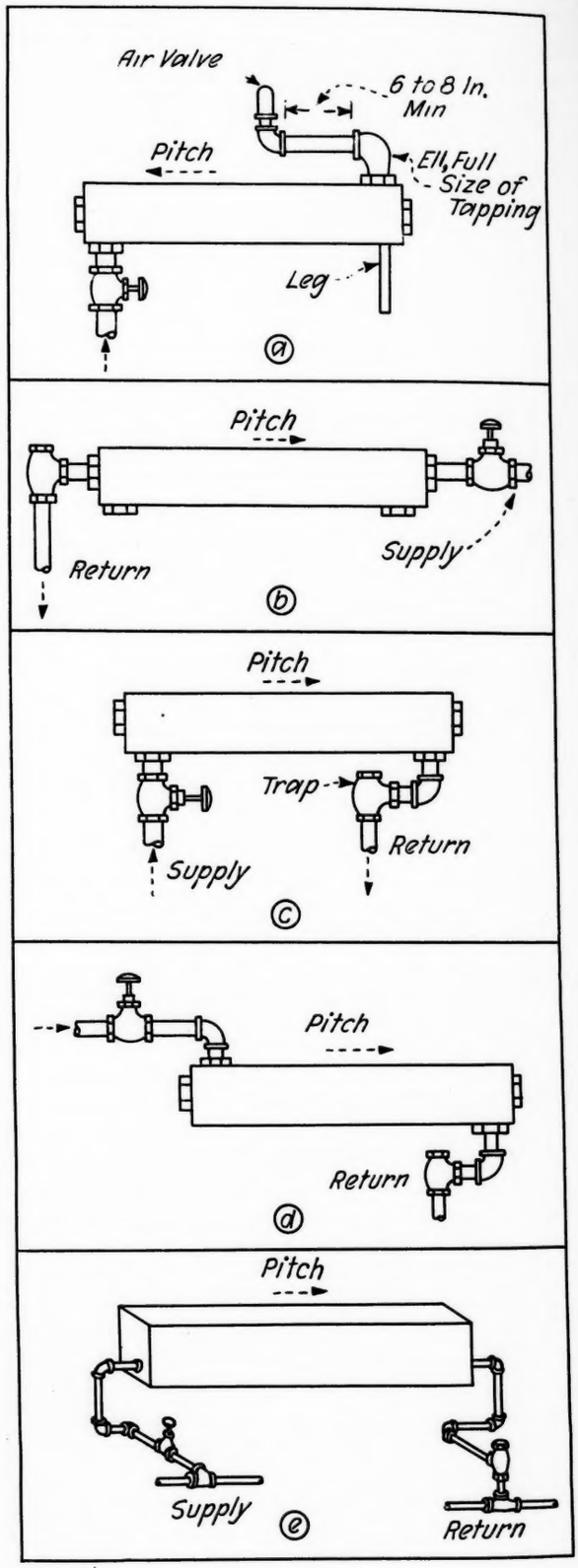

Fig. 1

with Gravity Convectors

Figs. 2a to 2d the covers "hug" the convectors closely at the ends and the full length of the cover is effective in heating. In 2c the valve and supply pipe are in the casing. This arrangement has the advantage of making the supply control valve readily accessible but may introduce objectionable control problems.

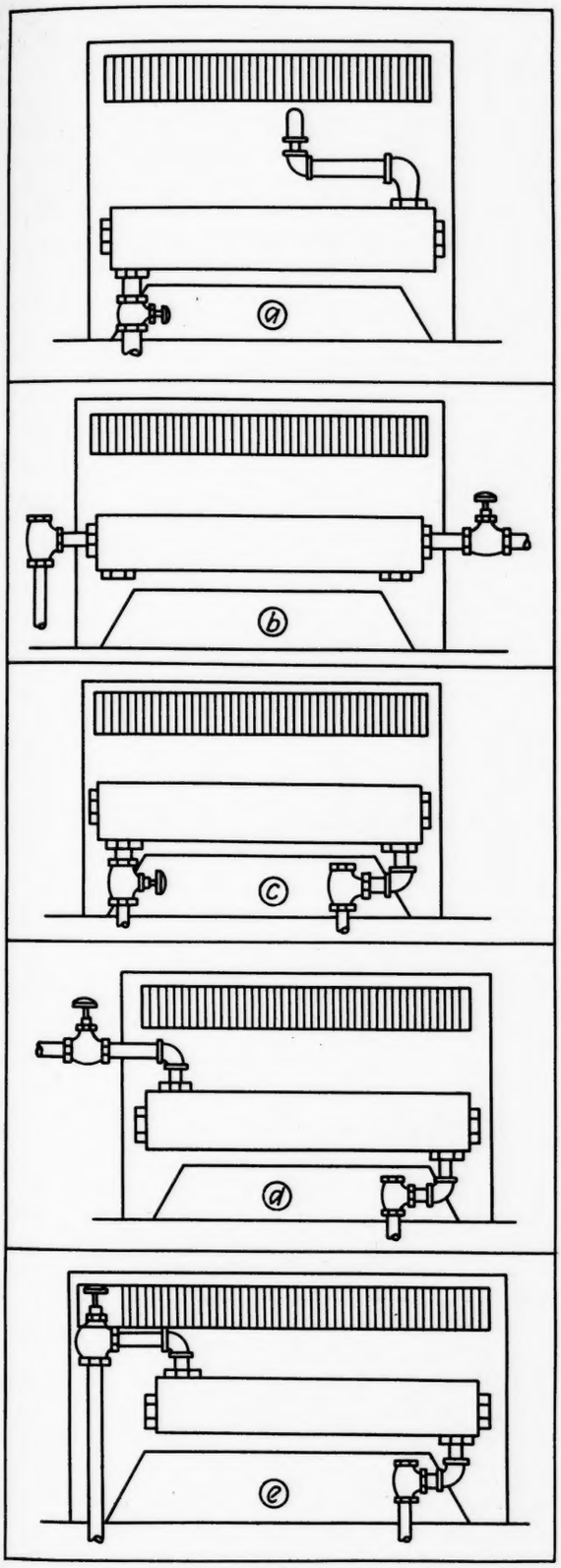

Fig. 2

It will be seen in all these diagrams that the location and arrangement of the piping around the inlet and the trap on the return line are either cramped or else they bring up possible operating troubles. One means of taking the valve and trap to more accessible locations is to locate them wholly outside the cabinet, casing or enclosure. Such an arrangement is shown in Fig. 1e where these accessories are in the basement near the supply and return main. While the arrangement shown can be applied only to convectors located on the first floor and when the mains are below, the general principle of keeping the accessories outside the convector enclosure can be applied in many ways where the local surroundings permit. It should be noted, however, that this arrangement separates the heating surface from the valve through which hand control must frequently be secured. On automatic control of the valve from a point in the heated space, the remote location of the valve can generally be worked out to good advantage.

Fig. 3 sketches an arrangement which is sometimes used with convectors, eliminating the inlet valve entirely and depending wholly on the damper for control of heat output. The convector is kept continuously supplied with heat but since heat is not conveyed to the air if there is no air circulation through the convector casing, a tight damper which could completely stop the flow of air would also completely stop the flow of heat. Either manual or automatic positioning of the damper can be used to give control of the heat output at fractions of the full-open to full-closed positions. The piping connections are brought up through the bottom of the casing essentially as shown in Fig. 1c and Fig. 1e.

While this principle of control through a damper can be used as the only means, it is evident that it can be incorporated into any of the other diagrammatic piping connections illustrated so long as space is available. Where control requirements make it desirable to do so control of air flows and inlet valve position can be combined at will.

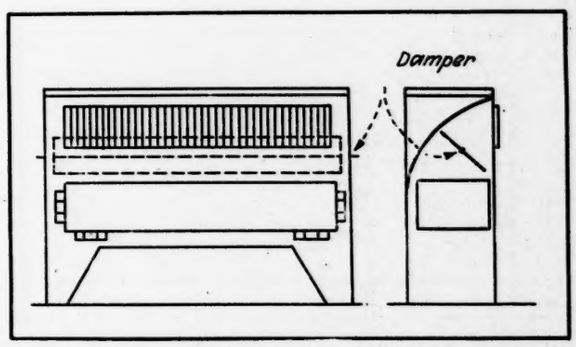

Fig. 3

Graphic Record of Building Heating Performance

By H. A. WARD† and L. T. TOWNLEY†

THE condensate from many of our buildings is metered. The size and the heating schedule of our buildings varies to the extent that the average steam per degree-day varies from 150 to 3126 lb. The meters on many of the buildings are read weekly and the steam used for heating is then compared with the corresponding degree-days.

Plotting the pounds per degree-days on the vertical scale and weeks on the horizontal scale with such widely varying units as 150 to 3126 lb. for the vertical scale, gave such widely varying graphic results that we hit upon the present plan of using the average steam per degree-day for a building taken over a period of a year or more as the zero line and plotting the percentage above or below this line in the vertical scale.

As an example the average steam per degree-day of Morrill Hall, as shown in the graph, is 320 lb. The steam used during the week ending November 30 was 42,600 lb. and the corresponding degree-days 157. Dividing, the steam used per degree-day is 271 lb., or 84% of 320 lb., the average which we plot as 16% under date of November 30.

With the above system, freakish weather condition, laxity in following or change in operating schedule or other variable applied to one or more buildings gives corresponding comparable curves for the building affected. Hidden leaks in returns, faulty meter operation, failure of temperature controls are clearly indicated.

Morrill Hall on February 8 and 15 indicated a leak in a return line which was buried under a floor. April 5 and 12 show the effect of a short operating schedule due to vacation. On April 19 the operating hours were not cut sufficiently to compensate for the mild weather. The same condition is shown April 19 on the Residential Halls plot.

Residential Halls were equipped with a new type of control November 23, which gave lower steam consumption than the average for past years. The high readings for February 8 and 15 were due to longer hours of operation due to term examination.

White Hall, December 28 to January 4, also April 5 and 12, had low steam consumption due to curtailed operating hours during vacation.

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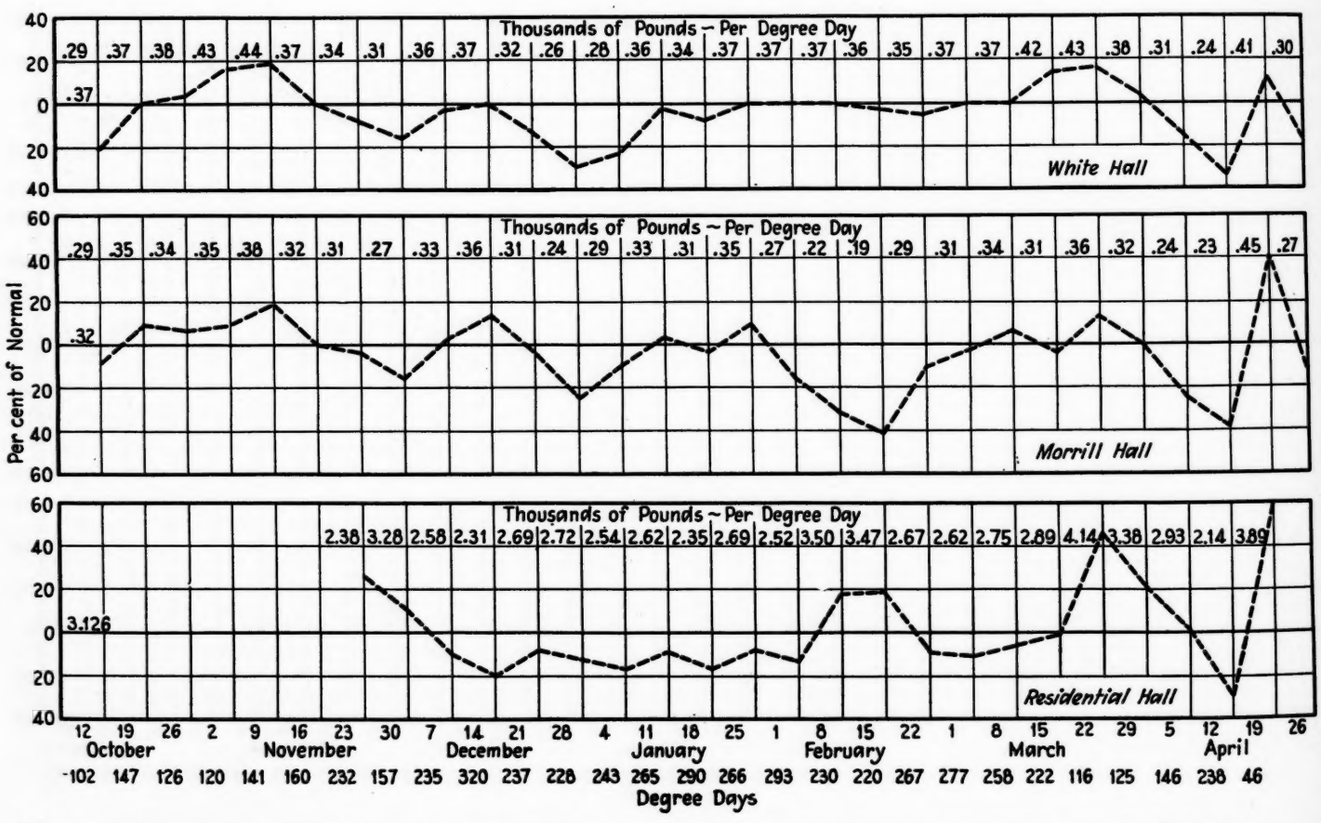

Fig. 1. Plotting steam consumptions as a percentage variation from the average as a base results in a chart which lets an operating official see at once not only when anything is wrong with any one building, but also gives a ready graphical comparison among buildings.

550 Tons of Cooling without Refrigeration in Mine Installation

By A. S. RICHARDSON†

Special cooling towers furnish all of the refrigeration needed to cool the Anaconda's Mountain Consolidated Mine at Butte, Montana. These towers are able to cool water for the mine air conditioning units to 50F even when the outside conditions are 90F dry bulb and 60F wet bulb. This seeming impossibility is achieved by utilizing a double cooling cycle in which evaporation is used to cool the water and part of this water is then used to lower the air wet bulb temperature to below 50F before it goes to the cooling tower. The accompanying article, describing this plant, has been abstracted from an article which appeared in Engineering and Mining Journal.

IN the ventilation of the Butte, Montana, mines the most important problem has always been the reduction of the high temperature and humidity of the air in the working places. Many sources of heat are recognized, but with the development of the mines to greater depth the constant increase in the temperature of the rock is of predominant importance.

With the increase in rock temperatures at greater depth, the heat imparted to the air passing through the inlet shafts and other main air courses is greatly increased, and thereby its capacity to improve conditions in the working places is reduced. In winter, air leaving the surface at a temperature of —20F is usually heated to a temperature of 65F or more before it leaves the inlet shafts at stations below the 3500-ft. level. A further increase in the temperature of the air ranging from 5 to 15F also commonly occurs in the crosscuts and laterals before it reaches the working zone.

Thus, in the face of an increasing demand for greater cooling capacity caused by higher ground temperatures, the increase in resistance to air flow caused by greater mining depth tends to restrict the volume of air in circulation, while the increase in the temperature of the air before it reaches the working places reduces its cooling capacity per cubic foot.

In the search for a solution to this problem an outstanding factor has been the exceptionally cold and dry climatic conditions existing in the Butte district. The average annual temperature is approximately 40F, and relative humidity during the summer months often drops to about 15 to 20%. Obviously, unlimited natural cooling capacity is available at a temperature range adaptable to air conditioning methods, and only a means of making this effective in the working zones of the mines was required.

During the summer months, the sensible temperature seldom exceeds for any length of time 90F, wet bulb temperature 60F, and dewpoint temperature 39F. Even during the month of July the dewpoint temperature often passes below the freezing point.

Since the wet bulb temperature is the temperature of evaporation, it is not possible by ordinary methods to cool water at a cooling tower below that point. Theoretical limits are seldom attained, so that assuming the water to be cooled to only 67F at the surface cooling tower, and that its temperature be increased by 5F in passing through the pipe line to the underground plant, it would then have a temperature of 72F, and this would be of little benefit in cooling mine air. Overcoming this difficulty was accomplished by devising a process that makes it theoretically possible to cool water to the dewpoint temperature, which is often as much as 20F below the wet bulb temperature.

The main features of the equipment needed for this purpose are shown in Fig. 1 and are the cooling tower and a heat absorber over which the air is passed and precooled before it reaches the tower. Two closed circuits of water circulation are used. In one of them the warm water returning from the mine is delivered to the top of the tower, and after being cooled falls into the sump, from which it passes through the main pipe lines to the mine and in return back to the top of the tower. In the other closed circuit, water is drawn from the sump by a pump and forced through the heat absorber in the air duct leading to the tower, and then back to the top of the tower.

To effect the precooling of the air before it reaches the tower, without changing its water vapor content, the heat absorber is constructed so that the heat exchange between air and water is effected by contact of the air with a large number of copper plates that are maintained at a low temperature. Essentially, the heat absorber is composed of a number of copper pipe coils upon which the copper plates are mounted. Water from the cooling tower sump circulates through the pipe coils in a direction counter-current to the flow of air, and by contact between the pipes and the copper plates the plates are cooled. In this manner both sensible and wet bulb temperatures of the air are lowered, but the dewpoint is not changed. Water passing through the pipe coils is heated to a temperature which may approach the sensible temperature of the air, or, possibly, 30F higher than the wet bulb temperature originally existing in the air.

The towers were designed to deliver water under average summer conditions at a temperature of 50F. The best performance was obtained on a day when the sensible temperature was 92F, wet bulb temperature 62F, and dewpoint 39F. Under these conditions the

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water was cooled to 48F. During the month of July, the warmest month of the year, the average temperature of the water delivered to the mine pipe line was 48.2F.

The two cooling towers now in use will be large enough to cool the full volume of 1000 gal. of water per minute after certain changes in fan equipment have been made to supply a larger volume of air. The main pipe lines in the mine shaft are 8⅝ in. outside diameter, grade B weldless steel tubing, and are heavy enough at the bottom of the shaft to withstand a bursting pressure of 2000 lb. per sq. in. with a factor of safety of 4. They are large enough to carry the full volume of flow without undue resistance, and are independently supported at vertical intervals of 500 ft. from steel bearers carried directly into the ground. Secondary distribution lines on the mine levels are 6 in. or less, as necessary, and are also designed to withstand the full working pressure with a factor of safety of 4. Both main and secondary pipe lines are insulated with 1½ in. of rock wool protected by a fire-retardant weatherproof sheet.

Design of the underground air conditioning plants has been subject to some changes, as indicated by operating experience. At early experimental units it had been found that with the lowering of the temperature and humidity of the mine air a large part of the dust carried in the air was removed by condensation of water vapor upon the dust particles as nuclei. The cumulative effect of this cleansing of a continuous large flow of air was the deposition of a film of precipitated dust on all the surfaces of the air conditioning equipment, and this naturally tended to reduce the transference of heat from air to water.

The first high-pressure mine cooling unit located on the 3500 level is composed of four groups of parallel-flow pipe coils which are connected in series and through which the cold water is circulated in a direction counter-current to that of the air. In connection with each of the four groups of pipe coils, a separate system of water sprays is used, for which the water is circulated by a pump in closed circuit. The action of these sprays is to wash the air and to transfer heat from it to the water inside the pipe coils. After having been sprayed into the air and in contact with the pipe coils, the spray water falls into a sump, from which it is drawn by the pump and again forced through the sprays. Between each of the four groups of pipe coils there are eliminators, or baffle plates, to prevent the spray water from being blown downstream.

With the cooling and dehumidification of the air in four stages it was found that about 90% of the dust by weight was removed at the first set of sprays, so that the effect of dust precipitation on equipment in the remaining three sets of sprays was relatively negligible. This has made it possible to work out some improvements in design which greatly reduce the size of the plants, and this is of considerable importance where the ground is heavy, as it is expensive to maintain large-sized openings.

In the construction of the second high-pressure unit on the 3600-ft. level there has, therefore, been installed only one set of plain pipe coils with spray equipment, and in place of the other three sets of coils there has

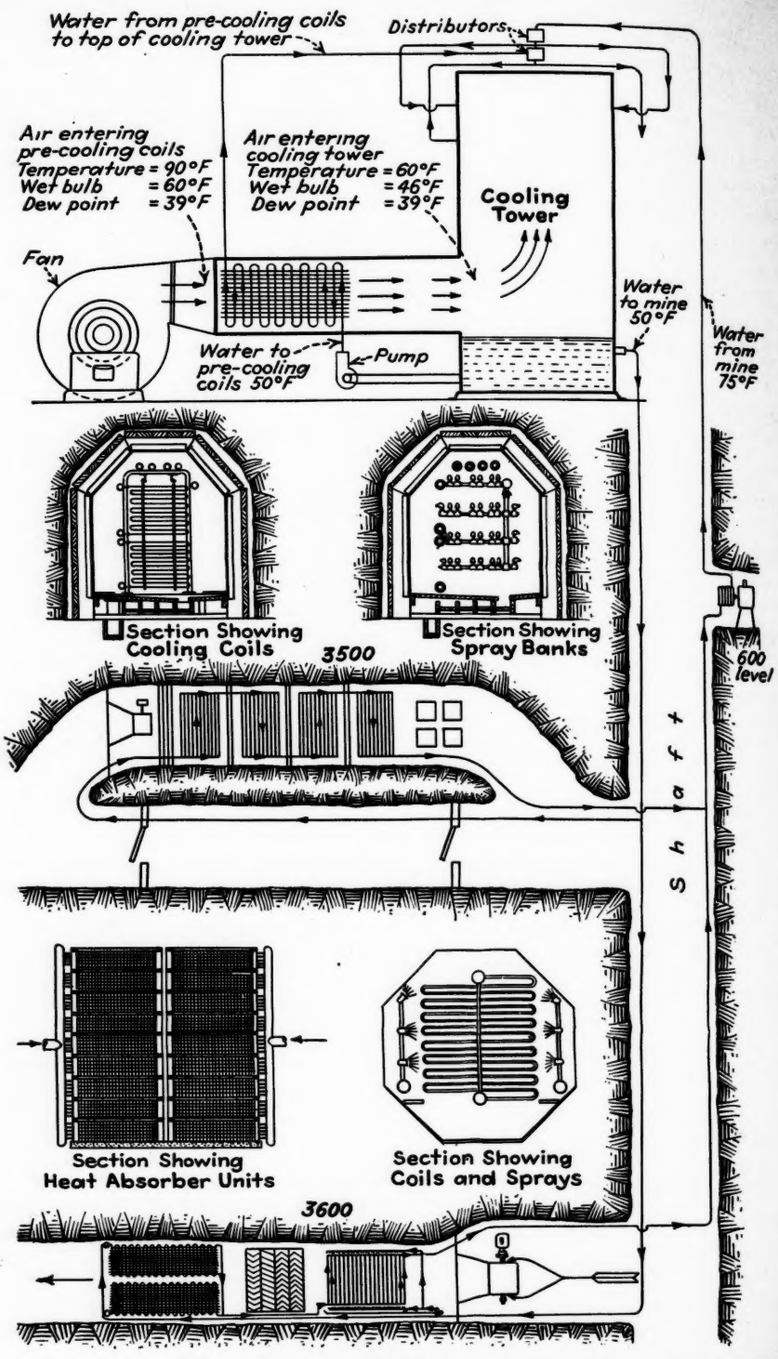

Fig. 1. The air conditioning method devised for the Butte mines. Water is cooled by means of a double cooling cycle in the cooling tower above the ground. It is then pumped to the various conditioning units in the mine.

been installed a heat absorber which is similar in design to that used for precooling the air at the surface cooling tower. Between the spray chamber and heat absorber a more elaborate set of scrubbers and eliminators, or baffle plates, has been placed to remove entrained moisture and dust from the air before it passes to the heat absorber. The space occupied by the heat absorber is less than one-twelfth that occupied by the three spray chambers. Special arrangements have been made for removing any precipitated dust, but in eight months of operation this has not yet been necessary.

On the basis of experience at experimental low-pressure units, the first high-pressure plant on the 3500-ft. level was designed to reduce the temperature of the air by about 15F, or from 80 to 65F on the wet bulb. With recirculation of a good flow of air in closed circuit, the lowering of temperatures in the section of the mine directly affected will result in a gradual lowering of the temperature of the air returning to the plant to a point at or somewhat below the 80F mark. However, when this plant was put in operation it was found more advantageous to the mine as a whole to operate it in reconditioning warm air from lower level developments, so that the temperature of the air entering the plant never dropped as low as 80F, and for that reason the air discharged from the plant during the summer months was usually higher than 65F. In plans for the next unit on the 3600-ft. level the design was changed so as to lower the temperature of air entering the plant at 85F wet bulb by 20F. The results are indicated in better plant performance and mine conditions.

With both the 3500-ft. and 3600-ft. units operating, and water circulating at the rate of about 450 g.p.m., the total cooling effect during the summer months averaged somewhat better than the equivalent of melting 550 tons of ice per day, and during the winter season in excess of 600 tons of ice per day. With the full circulation of 1000 g.p.m., it is expected that the average annual effect will be equivalent to the melting of 1200 tons of ice daily.

As the area affected by the first high-pressure plant on the 3500-ft. level had previously been cooled to some extent by a low-pressure plant having a capacity of about 50% of the new plant, the change in temperature conditions effected after this plant was put in operation does not completely record the improvement effected by air conditioning methods. The maximum improvement effected in any one place was from 90F to 78F, and the average reduction in fourteen working places was from a temperature of 86F, 83 wet bulb, to 80.5F, 78F wet bulb. As previously stated, the air entering the plant had a wet bulb temperature which was usually close to 85F instead of the 80F for which it was designed. Also, as the rate of circulation of water was only 200 g.p.m., instead of the full load of 1000 g.p.m., the flow through the pipe lines was slow and the increase in temperature of water between surface and plant was usually more nearly 9F than the 5F estimated for full operating rate. Both of these factors tended to cause the air to be discharged at a higher temperature than that planned.

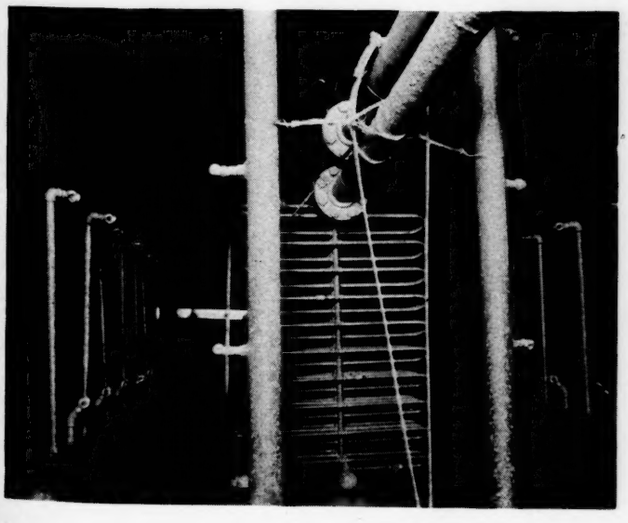

Fig. 2. Spray chamber of a 3600-ft. level unit. Water has been shut off to show interior construction.

In the area affected by the second high-pressure plant on 3600-ft. level little was done before starting the plant beyond making development openings, and only a few places were being actively worked. Most of the air discharged from the plant was coursed downwards to the 3800-ft. level and in return in closed circuit. The maximum improvement effected in any one place was in lowering the temperature from 94F, and 92F wet bulb, to 62F temperature, 62F wet bulb. The general average condition for fourteen working places of temperature 90.4F, 88.2F wet bulb, was lowered to temperature 76.9F, 74.4F wet bulb.

With the recirculation of air from an air conditioning plant through a section of a mine, much of the air originally supplied from the main circulation system for the ventilation of that section is liberated for the improvement of conditions in other parts of the mine. Thus, before the 3600-ft. unit was put in operation the average temperature of 103 working places was, during September, 1937, 87.1F, wet bulb temperature 83.7F. In February, 1938, after five months' operation of the plant, the general mine average for 95 working places was temperature 78.7F, wet bulb temperature, 75.3F. During this period of the year there would normally be some lowering of the average mine temperature, due to the change from summer conditions. It is difficult to estimate exactly how much the temperature of the whole mine would thus be affected without the operation of the air conditioning plant, but on the basis of experience during the same part of the year it would probably have been about 2F.

Among other effects of the operation of the plants that are of minor importance is a drying out of the mine workings, which has some bearing on ground conditions and repair costs. Also, there is decided improvement in the quality of the air, irrespective of temperature conditions. Carbon dioxide is seldom present in appreciable proportions in the air in the actively ventilated sections of the Butte mines, and in the air conditioned area the proportion is below the average, most tests showing about 0.04% at the intake to the plant and less at the discharge. Aside from this, however, the air conditioning process imparts a quality of freshness to the air that is distinctly perceptible at places so far distant that most of the benefit of temperature reduction is lost.

Sterilizing Air with Ultraviolet Rays†

By FREDERIC W. ROBINSON‡

IMPROVEMENT in our methods for sanitation, especially of food and water supplies during the past half century, has brought with it marked reduction in sickness and in the death rate from diseases affecting the intestinal tract.

This steady improvement in health standards has perhaps contributed to an almost entire neglect of sanitation in the air we breathe. It is highly significant, therefore, to find from authoritative statistics that as high as 85% of the deaths from infections and parasitic diseases are caused by microorganisms whose normal portal of entry is the upper respiratory tract.

The recent high rate of commercial development of air conditioning equipment and improved methods of air bacteriology have served to focus attention on the subject of air sanitation. Perhaps it will serve to prevent misconception of the subject if the aims and purposes of ultraviolet air sanitation are first defined. Air sanitation is closely analogous to water sanitation; its purpose is substantially the same—to make the air in confined spaces more safe under the particular circumstances of its use, and to guard against the possibility that air-borne organisms may cause clinical infections. Such applications may vary greatly in their technical details according to the type of problem presented. Most cases will fall into one of the following categories.

In hospital operating rooms the primary objective is to reduce the risk from pathogenic organisms settling from the air on the surfaces of open incisions, on instruments, or on the hands of the operating personnel from which they might be transferred into open wounds. Protection of perishable foodstuffs against contamination from air-borne organisms is a further example.

Meleny, Hunt, Beck, Hart, and others have clearly recognized the lack of adequate air sanitation in the hospital operating room. One may quickly determine by exposing blood agar plates how many bacteria may be expected to find their way by sedimentation on to an area of any given size during any given time in the operating room.

The technique of ultraviolet air sanitation in its relation to isolation wards for contagious diseases is under study by McKhann. He found that a light barrier set up in the corridor between wards may be made practically impervious to air-borne bacteria carried by ordinary ventilating currents. McKhann sounds a note of warning which is important in all air sanitation problems involving more or less permanently inhabited rooms, hospital wards, schoolrooms, hospital reception rooms, etc. He points out that, since the ultraviolet equipment must be so installed as to protect the eyes of those in the room (commonly, indirect lighting fixtures above eye level), the radiation serves to dilute the contaminated air with sterile air, and thus reduces but never completely eliminates the contamination so long as infectors remain in the room. With suitable design, however, installations with indirect lighting of this type may be made to show a degree of air sanitation equivalent to one hundred to five hundred or more complete turnovers of air per hour.

In air conditioned systems there are two types of cross infection to be guarded against—that which may arise within the room where an infector is located and the transfer of air-borne organisms from one room to another. The ability of ultraviolet rays to destroy bacteria was determined many years ago. Downes and Blunt made one of the earliest studies of this subject in 1877. Barnard and Morgan in 1903 showed that the most effective rays were those between 2265 and 3287 Å. wave length. In 1922, Klemperer and Kempner showed that ultraviolet was able to free the air of bacteria. In September, 1925, a patent was granted to Napier covering the withdrawal of air from a room and destruction of bacteria in the air by ultraviolet before its reintroduction.

Obviously, in the sterilization of air supply, where all of the air is under control, it should not be difficult by the use of quartz ultraviolet discharge tubes to insure complete sterility and to calculate the engineering design accordingly. In inhibition of infection by sedimentation and in the prevention of cross infection, however, since the bacterial contamination arises largely in the same chamber (from the noses and throats of the people in the room) in which the infected person is confined, complete sterility of the air becomes a hypothetical concept and possibly is not essential.

While it is pertinent, therefore, to differentiate sharply between air conditions where one or more sources of contamination are contained within the chamber, and other conditions where this is not the case, the problem remains always to make the air in question as safe as possible for the purpose it serves. This constitutes the whole problem as far as it concerns us here.

In conjunction with air conditioning systems, ultraviolet air sanitation offers profound benefits. Since, with the exception of a few special cases, the economics of air conditioning demands a recirculation of a large part of the air, usually 50 to 90%, the possibility of distributing air-borne organisms from one person to another can hardly be disregarded. In fact, this has in some instances prevented the installation of air conditioning equipment.

By the use of adequately designed ultraviolet installations mounted in the air ducts, satisfactory air sanitation has been provided in railway cars. Here the rate of circulation corresponds to twenty turnovers of air per hour. The rate of destruction of bacteria is dependent upon the rate of circulation; if the total rate of circulation is conspicuously lower than twenty turnovers per hour, some additional provision for ultraviolet radiation in the room would be essential for adequate air sanitation.

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†Abstracted from "Industrial and Engineering Chemistry."

‡Hanovia Chemical & Manufacturing Co., Newark, N. J.

Heat Transfer, Design, Physiological Papers Dominate 45th ASHVE Convention

Twenty-four technical papers on a variety of subjects in the heating and air conditioning field were presented at the 45th annual convention of the American Society of Heating and Ventilating Engineers, held in Pittsburgh, Pa., January 23-26. Over 560 members and their guests registered for the convention which started officially at Monday noon with a welcome luncheon. Later Charles E. Mayette addressed the society on The Position of the Consulting Engineer in the U. S. Housing Program.

At the first session the reports of the various officers and committees were presented, followed by the first technical session.

J. F. McIntire, newly-elected ASHVE president.

Thursday morning the following officers were installed: J. F. McIntire, president; F. E. Giesecke, first vice-president; W. L. Fleisher, second vice-president; and M. F. Blankin, treasurer.

At the annual banquet and dance the F. Paul Anderson Medal was presented to Prof. F. B. Rowley and the Past Presidents Emblem to E. Holt Gurney.

On this and the four following pages are summarized the technical papers presented.

AIR CONDITIONING

Air Conditioning in Industry, by W. L. Fleisher, A. E. Stacey, Jr., F. C. Houghten, and M. B. Ferderber.

During the past summer experiments were carried out to determine the physiological reactions of men while carrying on light work in atmosphere having effective temperatures from 77 to 92F with relative humidities of 60, 75, and 90%. The authors found that a rise in body temperature is a good index of disturbed physiological equilibrium and they recommend its use for limiting the length of exposure of workers in hot atmospheres. The limiting reaction is a temperature rise of 0.5F in the average worker qualified by physical make up and experience to work in hot industries or a rise of 1.5F in an occasional worker. The authors have prepared a chart to show the rise in body temperature to be expected for men exposed for different lengths of time in atmospheres of different effective temperatures when engaged in various activities.

FILTERS

Air Filter Performance as Affected by Low Rate of Dust Feed, Various Types of Carbon, and Dust Particle Size and Density, by F. B. Rowley and R. C. Jordan.

The work reported on in this paper is part of a program to determine the dust arrestance for low rates of dust feed through air filters, and filter performance when using different types of carbons, dusts of different particle sizes, and dusts of different densities.

Some of the conclusions of the authors were (1) In rating a filter it is not practical to duplicate the extremely low dust concentrations met in practice. It seems desirable in revising the Air Filter Test Code to increase the rate of dust feed.

(2) Generally dusts of large particle size are easier to filter from the air than similar dusts of small particle size. From the results thus far obtained it would seem preferable to screen all ash dusts through a 325-mesh screen.

(3) Lampblack and carbon black reduce filter life and dust holding capacity when used as a test dust. Both of these carbons approximate soot fairly closely, as far as their effect on filter arrestance is concerned. Further investigation should be made in an effort to standardize on a carbon for the standard dust.

(4) In general, filter life and dust holding capacity increase with increased dust density because of the constant volumetric capacity of a filter. There is a slight positive correlation between filter arrestance and increasing dust density. For these reasons dust density is an important factor in rating the performance of a filter on the weight basis.

(5) The present standard code dust of 50% lampblack and 50% Pocahontas ash probably penalizes the performance of most filters. On the other hand, the test dust consisting of straight Cottrell ash results in performance characteristics better than those obtainable in practice. It seems probable that a satisfactory standard dust may be made up of not more than two or three low density components.

OFFICE WORKERS

Reactions of Office Workers to Air Conditioning in Southern Texas, by A. J. Rummel, F. E. Giesecke, W. H. Badgett, and A. T. Moses.

A considerable amount of work has been done to determine the most desirable air conditions for comfort. However, most of this work was done in the northern part of the United States and the proper conditions for rooms in southern climates have been more or less a matter of conjecture. In order to remove this element of doubt, studies were made of the reactions of office workers to air conditioning in San Antonio, Texas. These studies showed that at an effective temperature of 72F, 90% of the occupants were comfortable, 5% mildly cool, and 5% mildly warm. A study of the reactions of the women indicated that the optimum effective temperature for women is about 2F higher than for men. Therefore for any large group of persons of both sexes an optimum effective temperature of about 73F is indicated.

PHYSIOLOGICAL

Physiological sensations were covered in the session on the morning of January 24 with President Gurney in the chair. Summaries of the papers at this session follow:

HOSPITALS

Air Conditioning Requirements of an Operating Room and Recovery Ward, by F. C. Houghten and Dr. W. L. Cook, Jr.

Recent interest in the application of air conditioning to operating and recovery rooms has led to the starting of a research investigation of the factors involved in and the desirability for air conditioning of operating rooms and recovery wards. The first part of the program on the determination of the best conditions to be maintained within the operating room and recovery ward is reported in this paper. Tests were made in a conditioned operating room and recovery ward in the Magee Hospital, Pittsburgh. Since the maintenance of a relative humidity of 50 to 60% is thought desirable to eliminate explosion hazards arising from static electricity, tests were made with various effective temperatures but with a relative humidity of approximately 50%. Surgeons and internes in the operating room were most comfortable with effective temperatures of 68F, the nurses at 69F effective temperature.

HEAT DISSIPATION

The Role of the Extremities in the Dissipation of Heat from the Body in Various Atmospheric and Physiological Conditions, by Charles Sheard, M. M. D. Williams, Grace M. Roth, and Dr. B. T. Horton.

Previous investigations have shown that for effective temperatures in the range from 66 to 72.5F, the control of loss of heat by radiation rests largely in the hands and that in the higher range of 70 to 75F, it is largely in the feet. In these studies, the authors found that under environmental conditions ranging from 18 to 22C the temperatures of the toes are, in general, at or near atmospheric temperature, whereas increased vasodilatation is occurring in the upper extremities as is indicated by the rise in temperature of the fingers. When the fingers reach temperatures of 33 to 35C, indicating approximately maximal normal vasodilatation, the temperatures of the toes exceed the environmental temperature. This ordinarily occurs under a room temperature of 25 to 26C.

Skin Temperatures of the Extremities and Effective Temperature by Charles Sheard, M. M. D. Williams, and Dr. B. T. Horton.

The series of experiments reported in this paper were made to study the skin temperature of the body under various conditions ranging from 66 to 77F effective temperature. The investigations showed that the relative humidity had little effect on the skin temperature of the body when the body is exposed to various effective temperatures from 66 to 77F or to fixed environmental temperatures of 73 to 82F with relative humidities ranging from 35 to 70%. It is the authors' conclusion, therefore, that, in the zone of body cooling, the dissipation of heat from the body is dependent chiefly on the environmental temperature and is little influenced by relative humidity when the person under test is in the basal metabolic state, unclothed and at rest in still air.

ENVIRONMENT

Recent Advances in Physiological Knowledge and Their Bearing on Ventilation Practice, by the Research Technical Advisory Committee, Dr. C.-E. A. Winslow, chairman.

This report deals with the physiological reactions to the air in ordinarily occupied rooms. One of the main points brought out was that the reactions of the body in cold and hot environments are radically different in nature. Experiments indicate that a clothed, semi-reclining subject exhibits normal and easy physiological regulation between air temperatures of 77 and 86F. Above 86F (called the zone of evaporative regulation) the individual adapts by active sweat secretion. Below 77F the skin temperature falls, but adaptation is incomplete and the temperature of the body tissues falls more or less continuously (zone of body cooling). In the zone of evaporative regulation, metabolism remains constant and increasing evaporative heat loss just balances decreasing heat loss and increasing heat gain due to rising operative temperature. In the zone of body cooling, metabolism rises a trifle, below 68F evaporative heat loss falls very slightly, and storage (cooling of the body tissues) rises sharply as heat loss due to convection and radiation increases.

An important point brought out is the very minor effect of variations in relative humidity.

BLOOD CIRCULATION

Cardiac Output, Peripheral Blood Flow, and Blood Volume Changes in Normal Individuals Subjected to Varying Environmental Temperatures, by Dr. F. K. Hick, Dr. R. W. Keeton, Nathaniel Glickman, and Dr. Harry C. Wall.

It is a known fact that the delivery of heat from the deeper parts of the body to the surface is accomplished chiefly by the circulation of the blood. As a result of studies made on two healthy subjects, one male and one female, the authors concluded that (1) cardiac output is governed by the heat production of the body; (2) blood flow through the periphery, particularly the hands, becomes very great as the mean skin temperature approaches the rectal temperature and (3) the blood volume rises within periods of two or three hours exposure to hot, wet conditions.

HEAT TRANSFER

The afternoon session of January 24, at which J. F. McIntire presided, was devoted to the subject of heat transfer. Summaries of these papers follow:

ALUMINUM

Some Reflection and Radiation Characteristics of Aluminum, by C. S. Taylor and J. D. Edwards.

To determine just how the amount of heat emitted or absorbed by aluminum foil insulation is effected by surface changes the authors ran a series of tests with an instrument designed to measure emissivity. They found that (1) while thick oxide coatings will have an appreciable effect on the emissivity the coating naturally present is too thin to have any appreciable effect; (2) thin lacquer films can be applied to aluminum, which are protective in nature but not thick enough to raise the emissivity above a value of about 10%; (3) colored dyes in lacquer films have little effect upon emissivity, but pigments have an appreciable effect; (4) surface roughening does not necessarily produce a surface of high emissivity and a bright polished aluminum surface is not an inherent requisite for low emissivity; (5) samples of aluminum foil used for thermal insulation under various conditions of service have shown very little change in emissivity over long periods.

GLASS

A Study of the Heat Requirements of a Single-Glazed Test House and a Double-Glazed Test House, by M. L. Carr, R. A. Miller, Leighton Orr, and David Shore.

Results of a study of the relative heat requirements necessary to maintain a temperature of 70F in each of two similarly constructed test houses, one having single- and the other double-glazed windows, is reported on in this paper.

Conclusions of the authors were as follows: (1) Because under the same conditions the inside surface of the glass in the double-glazed house will be warmer than the same surface in the single-glazed house, occupants of a double-glazed house will feel more comfortable than those in a single-glazed house. (2) The double-glazed test house required from 70 to 80% as much heat as the single-glazed test house. These ratios were affected somewhat by wind velocity, temperature difference and sun intensity, the ratio decreasing with increase in wind velocity and sun intensity, and with an increase in temperature difference.

WATER HEATERS

Heat Transfer in Storage Water Heaters, by D. W. Nelson and A. A. Rosenberg.

The purpose of the tests reported in this paper was to determine capacities and heat transfer coefficients in the common type of horizontal storage water heater consisting of a horizontal storage tank with an immersed bundle of copper steam tubes placed horizontally near the bottom.

A most interesting point brought out by these tests was that the heat transfer rate was greatest when the water was at atmospheric pressure and that it decreased as the water pressure was increased. For example, the coefficient of heat transfer decreased from about 650 B.t.u. per hr. per sq. ft. per F to about 230.B.t.u. at 50 lb. per sq. in. pressure. The authors attributed the high heat transfer at low water pressures to the fact that small steam bubbles are formed on the tube surface at low pressure and that when these bubbles break away from the surface they cause a turbulence. With the higher water pressure no bubbles are formed.

CONDENSATION IN WALLS

Condensation of Moisture and Its Relation to Building Construction and Operation, by F. B. Rowley, A. B. Algren, and C. E. Lund.

For the past two years an investigation of the causes of condensation, its effect on building construction, and the proper remedies has been in progress. This is the second progress report on the program and the conclusions reached from the investigation thus far made are (1) The several fundamental causes for condensation within buildings may be classified under either operating conditions for buildings, construction of buildings, or outside weather conditions. (2) The operating conditions which are usually subject to control are relative humidity carried within buildings and controlled ventilation of structures. (3) Overall vapor transmittance for a wall appears to be directly proportional to the vapor pressure drop across the wall providing that there is no condensation. (4) It is possible to reduce the rate of condensation within the structure by ventilating to the outside. (5) A good vapor barrier on the warm side of insulation is an effective method of dealing with the condensation problem at the time of construction.

(Left) Dr. R. W. Keeton of the University of Illinois, Department of Medicine, presented a paper on Blood Flow. (Right) Walter L. Fleisher, Chairman of the Society's active Committee on Research.

FUELS

A session devoted to fuels was held on the morning of January 25, 1st vice-president J. F. McIntire presiding. Summaries of the technical papers follow:

COAL SELECTION

Selection of Solid Fuels from the Viewpoint of the Small Consumer, by P. Nicholls.

In this paper the author confined himself to a consideration of some of the factors associated with solid fuels and did not include any comparisons of solid, liquid, and gaseous fuels. In his paper, he came to the conclusion that the most important decision a householder is asked to make is whether the elimination of smoke is desired.

FURNACES

Performance of Stoker-Fired and Hand-Fired Warm-Air Furnaces in the Research Residence, by A. P. Kratz, S. Konzo, and R. B. Engdahl.

The tests reported on in this paper were made in a warm air furnace in the Research Residence at the University of Illinois, using high volatile soft coal.

The authors found that (1) with a given indoor-outdoor temperature difference, the weight of coal burned in the hand-fired plant was less than that burned in the stoker-fired plant in which the over-fired damper was wide open, but was greater than that burned in the stoker-fired plant in which the over-fire damper was closed; (2) for a coal input rate of 48.6 lb. per hr., the electrical energy consumption of the stoker motor was 7.8 kw.-hr. per ton of coal fired; (3) the total time consumed in attending the furnace on an average day was 22 min. for the hand-fired plant and 9¾ min. for the stoker-fired plant.

SMOKE

Smoke Producing Tendencies in Coals of Various Ranks, by H. J. Rose and F. P. Lasseter.

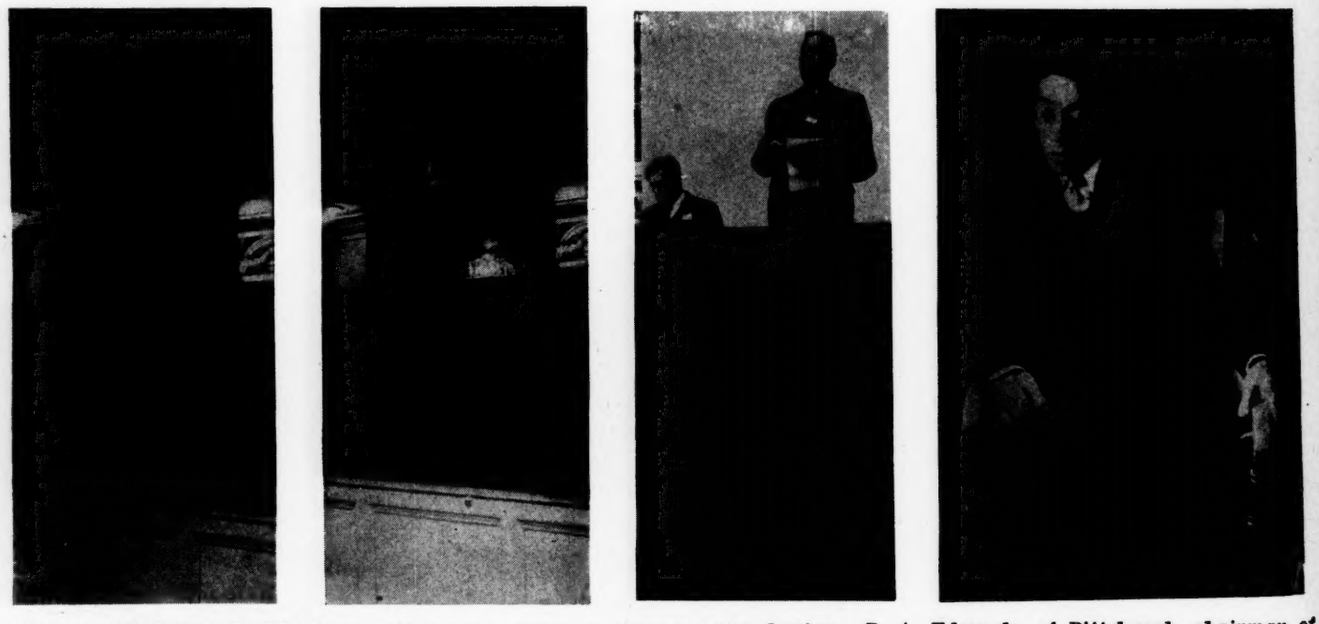
Others have reported that smoke production is proportional to the volatile matter of coal, which may well be the case with a limited range of coals, particularly of the bituminous class. However, the studies on which this paper is based have shown that the volatile matter percentage considered alone is not a suitable smoke index when coals of all ranks are included.

When it is desired to rate coals according to their smoke-producing tendencies, but without specifying particular combustion conditions, the tar yield in the Fischer retort test was recommended by the authors as a practical and sufficiently accurate index.

STOKERS

Small Stokers, by P. A. Mulcey and R. A. Sherman.

This paper was presented in two separate parts, one dealing with domestic anthracite stokers and the second with bituminous coal stokers. In the anthracite stoker section, Mr. Mulcey discussed the general mechanical aspects of this type of stoker laying particular emphasis on those parts of the mechanism which are peculiar to the burning of hard coal. He also drew a picture of the present state of development of stokers. Mr. Sherman, in presenting the section dealing with bituminous coal stokers, covered such subjects as the principle of operation, installation and sizing, process of combustion, coal selection, controls, and future market.



(Left to right) Prof. D. W. Nelson, author of a paper on storage water heaters; P. A. Edwards, of Pittsburgh, chairman of the technical sessions committee; Retiring President E. Holt Gurney (standing) and 1939 President J. F. McIntire (seated); Prof. S. Konzo, co-author of the paper on stoker and hand firing of warm-air furnaces.

DESIGN

President E. Holt Gurney presided at the morning session January 26, which was devoted to technical papers on various phases of heating and air conditioning design. Summaries of these papers follow:

HEAT FLOW

The Flow of Heat Through Walls, by F. E. Giesecke.

In this paper the author calls attention to the importance of considering heat storage capacities as well as the heat conductivities in calculations relating to the heating and cooling loads for air conditioning. In order to show how heat flows through walls, he presents a graphical method of analysis for tracing the heat flow and as an example he shows how heat flows through a 12-in. brick wall during a 24-hr. period. He then gives the results of an experimental study of the flow of heat through a 12-in. brick wall.

WEATHER

Analysis of Summer Weather Data in the United States, by J. C. Albright.

In order properly to design an air conditioning installation it is necessary to size the equipment for some outside temperature and relative humidity commonly known as design conditions. The determination of these design conditions for various cities in the United States was the purpose of this paper. The source of the weather data used in this study was the records of the Aerological Division of the Weather Bureau which records hourly dry bulb and dewpoint temperatures at many stations throughout the country. After analyzing these records wet bulb temperatures suitable for design purposes were selected on the basis that they were not exceeded more than 5% of the total hours during June to September, inclusive, of a normal summer. Dry bulb temperatures suitable for design purposes were selected on the basis that they would not be exceeded more than 5% of the 12 hours during the middle of the day in June to September, inclusive, of a normal summer. The paper includes five maps showing wet bulb, dry bulb, and dewpoint temperatures, summer wind data, and summer sunshine conditions.

Application of Summer Weather Data in Design, by John Everetts, Jr.

The purpose of this paper is to demonstrate the practical application of the weather design data compiled by Mr. Albright. In doing this the author first made an analysis of the various components of the load on an air conditioning system. Then to illustrate the actual use of the data in design, a typical air conditioning problem was assumed covering four representative cities and the calculated loads resulting from the use of the weather design data were analyzed and compared.

DUCTS

Frictional Resistance to the Flow of Air in Straight Ducts, by F. C. Houghten, J. B. Schmieler, J. A. Zalovcik, and N. Ivanovic.

Some time ago the Committee on Air Distribution and Air Friction laid out a program which called for a study of the frictional resistance to the flow of air in straight runs and fittings commonly included in air distributing systems. The first results of this program are reported in this paper which deals with the frictional resistance to the flow of air in 4-in., 8-in., and 12-in. round ducts and square ducts of approximately equivalent carrying capacity for the same equivalent resistance. The paper presents the relationship between the friction factor and the Reynolds number found for the round ducts. A modified form of Fanning equation is shown to apply accurately for the three sizes of ducts, justifying its use for ducts in a wide range of sizes. The paper presents friction charts for round duct without joints and for round duct with 40 joints per 100 ft. of run, ranging from 3 in. to 100 in. in diameter. Based upon the relation between the friction found for round and for square duct and assuming spacing of joints as found in common practice, a modified form of the conversion equation was developed for determining the diameter of a round duct having the same carrying capacity with the same frictional resistance as a given rectangular duct, and a conversion table based upon this formula is also presented. This paper is the result of work at the Research Laboratory.

HEAT STORAGE

The Effect of Heat Storage and the Variation in Outdoor Temperature and Solar Intensity on the Heat Transfer Through Walls, by J. S. Alford, J. E. Ryan, and F. O. Urban.

In this paper is presented a rational method for calculating the heat flow through a homogeneous wall that experiences a diurnal variation of air temperature and solar intensity on its outside surface, and is bordered at the inside by room air at constant temperature. The method avoids a determination or estimate of the outside surface temperature of the wall, and gives the heat flow into the room as a function of time, in terms of the wall constants and the design conditions of solar intensity and outdoor air temperature. The analysis shows that the amount of time lag and the reduction in amplitude depend upon the thickness and thermal properties of the wall, and can be determined easily from charts.

The authors state that the method presented here is sufficiently simple so that it can be used in practical applications where certain design outdoor and indoor conditions are assumed and where the walls are homogeneous.

Patients Control Air Conditioning in Dallas Hospital

One of the convalescing rooms in the Maternity Building. Patients control the operation of the room conditioning unit by means of a special switch hung near the bed.

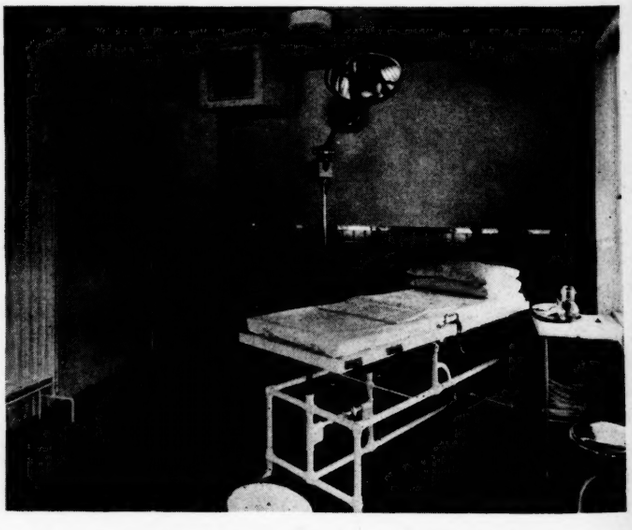
IN air conditioning the maternity building of the Baylor Hospital, Dallas, Texas, the engineers were faced with the problem of keeping noise at a minimum, having individual bedside control for both winter and summer conditioning, and maintaining special humidity conditions in all delivery rooms where anaesthesia is used. The maternity building, which is also known as the Florence Nightingale Building, is two years old and boasts of the most modern medical equipment.

The air conditioning system decided upon is of the indirect type having a basement condensing unit which cools water which is then distributed to ceiling units in each room. Ammonia is used as the refrigerant. During the winter the water is passed through a heater before going to the air conditioning units. Outside air is supplied to the ceiling units by ductwork so that the windows may be kept closed while the system is in operation.

Since the relative humidity in the delivery rooms must be maintained above 60%, individual humidifiers are kept in these rooms as well as in the baby incubator rooms. Temperatures as high as 100F are maintained in the incubator rooms by special steam lines. To prevent the spread of germs carrying infectious diseases individual air intake and exhaust ducts are provided in the incubator rooms.

Patients have control of the operation of their room units by means of a special switch which is hung next to the bed or wheelchair in the room. This switch controls the speed of the blower in the conditioning unit and thus regulates the amount of conditioned air entering the room. The warmest air in the winter and the coldest air in the summer is obtained by a single pull of switchcord while the second and third pull tempers the hot or cold air.

The air conditioning installation was made by the Baker Ice Machine Co. of Texas; H. S. Ashley of Fort Worth was the engineer, Mark Lemmon of Dallas the architect, and J. S. Jacobs of Fort Worth was the engineer in charge.



(Left) The completely air conditioned Maternity Building of the Baylor Hospital, Dallas, Texas. The conditioning system is of the indirect type, using ammonia as a refrigerant. (Right) One of the delivery rooms showing the ceiling type unit used for conditioning the air. The relative humidity is maintained above 60% in these rooms.

Governing Considerations in Planning Heating Systems for Multiple Low-Cost Housing

By CHARLES E. MAYETTE†

Large apartment house groups put up for rental purposes are now being constructed and others are being planned both by public housing authorities and by large private financial interests. What is to be done about adequate and economical heating for them is one of the most interesting current questions. The author, who was associated with the engineering of the government-promoted housing developments constructed with PWA money, gave his thoughts on this before a technical group at the Engineers' Club in Baltimore recently.

WE are gradually coming to realize as engineers, that the technical side of engineering has too long overshadowed the paramount objective of practical commercial application. This, I believe, has been brought to light by the active participation both by the government and private interests in the mass application of large scale multiple housing projects.

As we review the engineering practice of ten years ago we cannot fail to note the adoption of improved methods in the past years concerning the approach of the problem of analyzing the objective of any construction project. This was naturally brought about by a sustained depression and now fits nicely into low-cost housing.

I assume that we all agree that the new technique had to come, and that the progress and performance on a sound business basis of multiple housing depend on all such changes or new thoughts intelligently made. You will undoubtedly also agree with me that this has necessarily meant new products and new industries as well as changes and new applications of existing products.

We cannot fail to realize that the rhythm of life has changed tremendously of late. Sales organizations, once nationally strong in the praise of their particular company's administration and manufacturing policies and always particularly adept at pepping up the selling of the established products without due regard to whether the commercial application of those products would result in praise or damnation of the installation, are now giving much more time and thought to consideration of the application, and what is more to their everlasting credit, do not hesitate to request that the method of application be modified to protect their equipment in certain classes of commercial application. Furthermore, where it appears impossible or impractical to make the overall change requested as sometimes occurs, manufacturers do not hesitate to withdraw from the picture. This is something that heretofore was generally disregarded in the desire for sales. This one improvement in manufacturers' sales and engineering policies will in itself do more to improve mechanical equipment systems in the years to come than any of the one hundred and one selling points that crop up from time to time.

Personally, I believe that at the present time, there are sufficient types and kinds of heating equipment and associated equipment to develop suitable and economical mechanical equipment systems well within the range of costs, both initial and annual, required by any sound long term public or private program. We need only combine the available products with intelligent experienced engineering analysis, laboratory research, dependable field surveys and practical commercial application.

The government has clearly recognized the need for this method of approach on its own programs, so much so that it now has in full swing an extensive research program on building materials and structures for use in low-cost housing. This program covers mechanical equipment as well, and the results of the program are for national consumption. I urge that each of you keep in close touch with this program, as your active interest will be not only useful but very much appreciated.

If engineers are to fulfill their obligations to the client, be it public or private interests, they cannot avoid the habit of thoroughness, regardless of the time and effort it may entail. The engineering profession must contribute its share to the burden of local and nationwide research work and investigations. These must be patiently carried out until a consistent cross-section of the dependability and usage of materials, equipment, and fuels peculiar to low-rent housing have been established.

This research and investigation work calls for the inspection of mechanical equipment and systems in existing private and governmental housing projects, as well as the manufacturing plants producing housing equipment. Owners, superintendents, maintenance and repair records, tenants, artisans, contractors, and representatives of local municipal agencies must be inter-

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viewed and consulted on all phases of housing. Some of the many subjects to be studied include: specifications, competition, economy, contractual relations, purchase and delivery of available fuels, the cost of administration, estimated life of material and fuel resources, and the particular application of overall design principles. Bear in mind that the degree of sincerity with which you discharge this responsibility to your client will not only have an important bearing and effect on the much needed rehabilitation of the housing problem, but will promote the much needed practice of the principle of commercial justice to manufacturers as well as to the fuel industries, which in turn will be a main contributing factor towards recovery.

Elaborate and costly mechanical equipment installations have no place in housing developments regardless of who is furnishing the financial backing. The entire mechanical system must be appropriate to the size and type of housing involved; must suit the class of tenant to be housed, providing for the maximum conveniences of the lowest acceptable scale of living standard in the locality served.

Research should consist of investigating in a broad field and recording the character of equipment in use for a period of at least ten years, as well as gathering the facts from the field regarding maintenance repair, and replacement.

The final recommendation is, of course, a direct result of the research and, although the application of the findings must be suitable to local conditions and codes, it must also keep abreast of latest improvements in design and anticipated trends.

It is also of paramount importance that the justification of recommendations be so definitely established that the resulting self-emphasis will carry them through.

It is also absolutely necessary that you lend your invaluable aid to bring about a closely coordinated overall housing development design by definitely coping with the mechanical problem at the outset. This not only will establish a greater respect for mechanical equipment but will eliminate the spending of unnecessary money on designs and redesigns and changes of policy with a view to creating a mechanical scheme so flexible and oscillating that it can keep pace with the widely varying changes of projects from the time of their inception to the time of completed land acquisition and issue of the plans and specifications for bids.

I believe we are in full agreement that there can be no fixed policy in the selection of the type of heating system or for the design of such, as variations of climate, custom, local cost, type of fuel, and of the buildings themselves will dictate a wide range of difference for each housing development.

The effect of the number of stories upon heating costs, both initial and operating, must be considered. Unit costs increase at a greatly accelerated rate as the number of stories decrease. This should not lead to the conclusion that tall buildings are to be favored, as there are a great many factors to be taken into account, but it does indicate that the one-story dwelling cannot be economical except in extreme cases.

For individual houses, row houses and flats, where a combination of low retail fuel and utility cost exists, and where it is the intention or established policy that the tenant shall furnish the necessary fuels and attendance for heating his living quarters and providing his own domestic hot water, simple and direct heating systems can be provided requiring the minimum attention and maintenance and of a capacity to meet the full heating requirement, including the hot water load, if so arranged.

In a general review of simple types of heating systems, I wish to comment on the following, believing them for the moment to be the most readily applicable to the problem at hand:

Heating Single Houses

TYPE A: 1. A warm air furnace system, of which there are two types, both requiring at least a partial basement or separate utility room.

(a) The pipeless type discharging the heated air through one outlet at the first floor line, usually in the main hall, with necessary return or recirculating ducts.

(b) A gravity warm air furnace system, distributing the heated air through a series of metal ducts to predetermined points of discharge in the rooms to be heated. This system may or may not be equipped with return or recirculating ducts. Both of the above systems, if properly designed, will heat the home satisfactorily, at a low initial cost and with a minimum of maintenance and adjustment. The comparative analysis must, however, take into consideration that the replacement cost will run somewhat higher than steam or hot water systems. There are several other classified types of warm air heating which include forced warm-air distribution and positive returns. All of these should be given due consideration.

2. A one-pipe system of steam heating using direct radiation. This system is more economically applied with a full basement and when properly designed and vented will give satisfactory results.

3. A two-pipe hot water heating system with boiler located on first floor or in partial basement, using direct radiation. This system when properly designed will also give satisfactory results.

In the case of anthracite or bituminous coal, stoker or hand fired, or oil fired boilers, partial basements or separate utility rooms should be provided. In the case of a gas fired boiler, the boiler may be located on the first floor but the unit should be totally inclosed in a separate utility room or closet. If the closet is used in lieu of the utility room it should be ventilated by means of an individual louver to atmosphere and with a grilled or louvered door on the dwelling unit side and preferably should be lined with a heat and fire resisting sheathing.

Generally speaking, the foregoing systems of heating for individual homes, row houses and flats are so nearly the same in initial costs because of unequal varying local labor and material costs, that the choice becomes one of local practice and temperament. The engineering survey will usually suffice to establish the one most acceptable to the locale, but the choice should not be made to the exclusion of the facts of the economic analysis taking all costs into consideration.

Heating Multiple Projects

TYPE B: On large scale multiple housing projects

consisting of apartment unit groups of two, three, four or six-story buildings, with pipe spaces or basements, the choice between a central steam heating plant, or several group steam central heating plants, or the choice of a multiplicity of small hot water heating plants, should be based on a careful and intelligent analysis of all conditions affecting the particular housing development.

In considering the economics of the problem, cost should be understood to include all construction items such as boiler rooms, chimneys, outside areaways, necessary coal and ash distribution facilities, smoke nuisance, type of fuel, method of firing, ash removal, water and miscellaneous supplies, cost of utilities, labor, maintenance, replacements, and fixed charges.

As a rule, a well planned symmetrical and rectilinear grouping of apartment buildings with roads and walk ways giving the necessary access for coal delivery and ash removal will favor the use of so-called low pressure group central plants, particularly where the site plan lends itself to the interconnection of these group plans, thus permitting more flexible operation and minimum labor expenditures during the low demand-load seasons.

However, the major controlling factor is that of the type of available fuel, be it anthracite, bituminous, oil or gas. This plays an important part in the final decision and should be thoroughly analyzed.

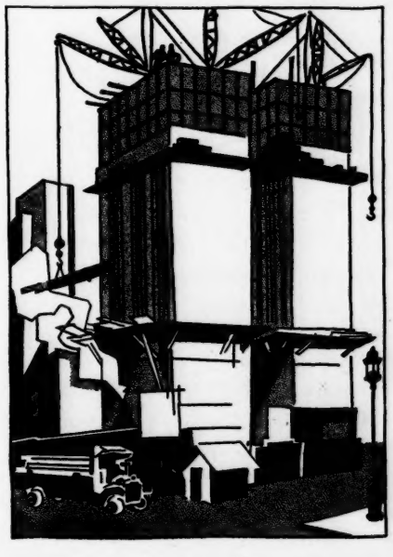
Heating in Mild Climates

TYPE C: Where heating requirements are not severe and fall within the temperature difference class of 40F, none of the above described heating systems appears justified. For such localities there are several types of heating equipment on the market and choice again depends a great deal upon the fuel available locally. The following describes some of the better known systems.

1. Where wood or anthracite coal is plentiful, a built-in metal fireplace which has an air space or plenum chamber and outlets for the distribution of heated air circulating around the fireplace back and side. The principle is quite similar to that of a warm air furnace, and also has been more recently applied to a water jacketed semi-fireplace unit in connection with direct hot water radiation.

2. Where the building costs do not permit a fireplace, the anthracite coal, wood, or oil burning cook stove in the kitchen will undoubtedly serve to keep a one-story dwelling unit comfortable. For two-story dwelling units, an additional flue should be provided to permit the use of coal, oil, or gas fired circulating heaters to compensate for second floor heat losses.

3. Also, several experimental units are being developed. These units combine cooking, domestic hot water and either a hot water system of heating with direct radiation or forced circulation of warm air, similar to units now widely used in Europe. The fuel best adapted for such units is anthracite hard coal and these units have possibilities for the milder climates, but I am not convinced of their desirability for severe sustained cold weather.



In addition to this partial list of the heating systems available, there is a modification of the two-pipe upfeed gravity vacuum return direct radiation heating system that I wish to call to your attention because I believe it has great possibilities, particularly from the standpoint of initial cost. Indications are that it will reduce the initial cost of a two-pipe vacuum job as much as fifty dollars per apartment unit, and this sum multiplied by anywhere from 600 to 3,000 units is important money. In simple terms, it can be called an individual apartment space heater system. Recent experiments on such an installation indicate adequacy and sound commercial application.

The space heater is steam coiled and is equipped with a three-speed fan. The steam coil inlet is equipped with a self-contained liquid thermostatic on-and-off valve actuated by the discharge and temperature at the dining room supply grill. The return is equipped with a regular thermostatic trap.

The total output capacity of the space heating unit should be figured with a final air temperature not to exceed 120F at the supply duct grilles with the fan running at high speed; with a 25% capacity while drifting without fan running, 50% capacity at low speed, and a 75% capacity at intermediate speed. The unit should be equipped with a switch plate reading "Off," "Low," "Medium," and "High" speed settings. The motor should be of the variable speed type with maximum "high and low" range. The unit should be provided with a shut-off valve in the event that the drifting capacity exceeds the mild weather demand. The return grille should be located near the floor in the living room.

The discharge from the unit should be carried into a plenum chamber where the air will be well mixed and the temperature across the duct will be fairly even. If necessary, adjustable baffles should be installed to thoroughly mix the air from all parts of coil. Plain rectangular straight gravity ducts should be extended from the plenum to each supply outlet; velocity in these ducts not to exceed 250 f.p.m. Velocities not in excess of 350 f.p.m. should be maintained at each supply outlet. The velocity through the return air grille should not exceed 400 f.p.m. Horizontal deflecting grilles and vertical air deflectors should be used at each supply outlet, which will cause the air to travel uniformly throughout the room. Specification for pipe, pipe fittings, gate and globe valves, thermostatic traps, and float and thermostatic traps, hangers, as well as piping layout and pitch should be the same as for a regular two-pipe upfeed vacuum return system of heating.

Both the two-pipe vacuum systems and the modification of that system that I have just described lend themselves admirably to centrally con-

trolled heating. However, before going into the subject of control, permit me to make a brief statement on fuel.

One of the major contributing factors to the cost of rents, or stated more clearly, the total annual cost per room per month to the tenant is that of fuel, fuel-burning equipment, and the entrained labor cost thereof. On applied mass heating, therefore, fuels such as anthracite coal, bituminous coal, oil and gas must be thoroughly analyzed, and every possible justifiable saving device should be used to insure the lowest possible rent to the tenants. Obviously, each fuel bears a distinct relation to the labor required and the equipment necessary for its proper and efficient combustion.

I have had very little to say about the matter of stoker equipment because I don't believe that there is a great deal to say. It is generally understood that stoker firing is paramount to economical operation, high efficiency and controlled heating. I would strongly urge, however, that you use, whenever possible, the combination type of solid fuel stoker permitting the firing of either anthracite or bituminous coal as justified by the economic fuel cost analysis, per room, per month.

As to boilers, there are various suitable types all adapted to automatic firing and control. For central plants you have a wide selection of water tube boilers with three or four drums. For group plants, the portable type of firebox boilers, or the residence type of steel or cast iron boilers.

Now, a word about combustion controls. In some cases simple controls are required. In other cases complicated controls are required. In any event, you should not fail to take into consideration hazards, shorter life of equipment, as well as simplicity and less labor attention. In addition to all these factors, the choice in close competition should give favorable consideration, particularly in the case of solid fuels, to cleanliness, price stability, and adaptability to automatic firing and controlled heating.

It is thought to be quite a humorous sally in this day and age for some man to strike a pose and say "You may say for me that I believe the automobile has come to stay." Personally I am not going to strike a pose, but I am going to say that I believe that "controlled heating" is here to stay. Records prove beyond a reasonable doubt that controlled heating can readily account for fuel savings of upwards of 25% on a large scale housing project, let alone that very little mentioned fact that the labor of firing this fuel is also saved.

Controlled heating divides into two types of systems, the "continuous flow" and the "on and off."

Both of these systems to which you must give consideration in discharging your responsibility to your client in assuring him the soundness of his long-term investment, are manifestly "result" systems. Whether a manufacturer employs a radiator device, an inside thermostat, or a high vacuum, or a combination of all these; or employs an outdoor thermostat with or without an indoor thermostat; or whether the system is designed with or without orifices, program control, remote control, remote manipulation of changing demands thermostatically or manually, does not enter into the picture to the exclusion of the final results—that of *saving fuel*. The matter of Swiss watch accuracy temperature control within one degree or two degrees cannot possibly be applied to mass multiple housing.

The initial cost of controlling heating is of paramount importance in the justification of your choice. If a simple system of heating control, be it continuous flow or "on and off," will give the results, in my opinion it would be difficult to justify a widely varying initial cost.

When the elaborate claims of some manufacturers have been thoroughly analyzed it may be found that the greater majority of the publicized features basically do not lend themselves to greater economy, but are for the most part selling points. Extensive research in the field of controlled heating will disclose that the one system will save just as much as the other system when properly applied commercially.

Whereas systems of both types have indisputable evidence of annual savings as high as 40% in fuel, a thorough analysis will convince any engineer that competent properly applied operation and maintenance could have accounted for at least 50% of the annual wastage involved.

Particular consideration should also be given to the simplicity of a system from a standpoint of maintenance and repair as well as to its automatic adaption to the heating program that is anticipated in the particular housing development you have under consideration.

A searching study of the heating controls field brings out the interesting fact that there is an intermittent operation heating control with one additional automatic device not possessed by any other system of either type, namely, that of anticipating weather changes regardless of the predetermined clock starting-up time. This feature is not only a saving device in the case of unlooked for mild weather, but also acts as a protective device in the case of unseasonable heating demands, without the troublesome and costly features of emergency resettings.

Above all, remember that each and every project is a separate individual control problem. The number of buildings and units, the density, number of stories, wood or steel windows and the orientation all have an important bearing on the choice.

Many projects do not lend themselves to either continuous flow or on-and-off and should be redesigned to suit. On the other hand, some layouts (if you are continuous-flow minded) will not permit the application of the on-and-off, although a few simple changes will permit competition on both types of systems. The base design of the heating system, uncontrolled, must be capable of 100% returns by gravity and adequate emergency heating in case of a breakdown of the controlled heating equipment.

Don't try to solve control heating by reading catalogs. If you are in doubt call for the manufacturer's chief engineer to help you on the layout and remember that the objective is the reduction of the fuel bill.

In reviewing this subject of controlled heating, I have endeavored to impress upon you that the choice of controlled heating is not one to be influenced by high pressure or profusely illustrated catalogs, but one that must be decided on the cold facts of results. The result sought is not split-hair temperature control for mass housing, but for reasonable and substantial annual fuel savings which directly reflect themselves in the goal of housing economy.

Summer Degree-Hours

The summer air conditioning load includes not only the absorption of sensible heat from outdoor air but in addition the latent heat of the moisture in the air, solar heat, and heat from appliances and human beings. Consequently, for most types of buildings it is not possible to show any relationship between outdoor dry bulb temperature and the energy required for cooling. However, such a relationship has been found for certain residences where the energy used for cooling has been found to be in proportion to the number of degree-hours above 85F. This relationship, which has been noted in investigational work both at the University of Illinois in Urbana, and in Detroit by the Detroit Edison Company, may not apply in parts of the country where the climate differs sharply from that in Illinois and southern Michigan. Nevertheless, since 85F is the upper limit of dry bulb temperatures within the comfort zone, a count of these degree-hours is of interest and value to the engineer even if the relationship mentioned did not exist, and such a count is here presented for a fair number of cities.

Definition

The number of degree-hours above 85F is determined by subtracting 85 from the dry bulb temperature. If at 2 p.m. the temperature is 93F, there are 8 degree-hours that hour. The total of these for every hour during the summer that the temperature is over 85F gives the seasonal total for that year.

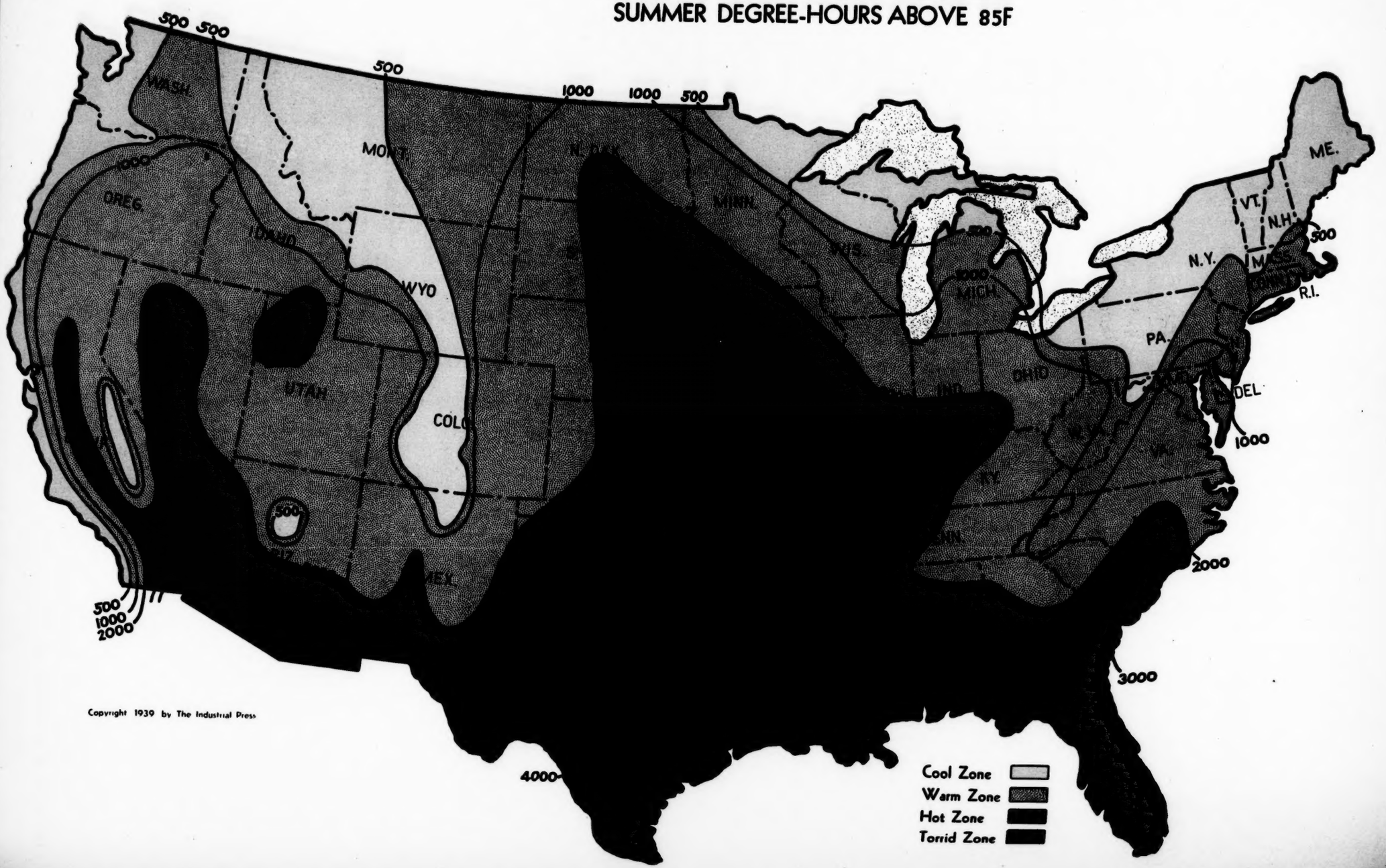
Such a count requires hourly dry bulb temperature readings and these are not readily available for a large number of cities and the work involved makes it impractical for such a count to cover a wide range of years. The information here presented covers the years 1932 to 1937, inclusive—years believed to include both extremely cool and extremely hot summers.

The Map

The accompanying map plotted from these data shows graphically the extreme hot belt existing in the southwest where the number of summer degree-hours in a few cities averages well over 7000 degree-hours per season. The map also shows relative coolness of the Pacific Coast, upper New England, New York, Michigan, Wisconsin, and Minnesota. It brings out forcibly the fact that the extremely southern states do not have the extreme sensible heat load expected in parts of the corn belt, Oklahoma, and Texas. The map is believed to be accurate east of the Rocky Mountains and along the Pacific Coast but

Text continues following Map and Table.

PROBABLE AVERAGE NUMBER OF SUMMER DEGREE-HOURS ABOVE 85F



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PROBABLE MAXIMUM, MINIMUM, AND AVERAGE NUMBER OF SUMMER DEGREE-HOURS (85F) PER YEAR

City	Probable Maximum	Probable Minimum	Probable Average
Amarillo	5050	2700	4632
Baltimore	2200	1000	1898
Birmingham	3910	2400	3015
Bismarck	4650	1000	2129
Boston	740	200	404
Buffalo	115	10	73
Chicago	1800	500	1070
Cincinnati	3940	1000	2146
Cleveland	720	150	392
Columbus	2800	850	1607
Dallas	9200	4400	6414
Denver	2070	900	1394
Des Moines	6570	1450	3574
Detroit	1900	450	1054
Duluth	1020	20	286
El Paso	8160	4700	6387
Ft. Wayne	2750	530	1547
Grand Rapids	1950	440	1147
Houston	4200	2900	3796
Indianapolis	4450	830	2175
Kansas City	12400	2500	6788
Memphis	4730	2000	3208
Milwaukee	1100	400	758
Minneapolis	3020	1150	1877
New Orleans	3500	2070	2976
New York	570	60	375
Oklahoma City	11650	4100	7342
Omaha	7820	1940	4783
Philadelphia	1350	560	1013
Pittsburgh	1270	280	827
Portland, Ore.	860	170	377
Richmond, Va.	2500	900	1871
Salt Lake City	3600	1700	2762
San Diego	20	0	7
San Francisco	50	10	28
St. Louis	8370	2260	4475
Savannah	3540	2300	2977
Toledo	2070	570	1206
Topeka	12650	2500	7378
Washington	1950	1270	1601
Wichita	12790	3600	7195

excepting for the figures for Salt Lake City and Denver, no particular accuracy is claimed for the map in the Rocky Mountain states due both to the topography of the country and to the difficulty of obtaining hourly dry bulb readings.

It is emphasized that this map is no criterion of the average air conditioning loads for all types of buildings. It is designed only to show the relative severity of that part of the air conditioning load due to the sensible heat of the air.

Variation from Average

The number of degree-days during a heating season varies little from year to year in a given locality and, consequently, enables that unit to be used in predicting probable fuel consumptions. No such use can be made of the degree-hour for the reason that in most parts of the country the number of degree-hours varies widely. For example, in the period covered by this study, the number of degree-hours in Detroit during one season was only 1502 while in another the total was 6560. Similarly, in Philadelphia the total one year was 577 and in another 1340. In general the extreme variations were found in northern cities, whereas the southern cities tended to show less variation. For example, the count for New Orleans during the low year was 2078 and during the high year 3491.

Extreme variations also prevailed in the very hot belt labelled as "Torrid" in the map. The highest single season count during the period was 12,789 in Wichita, Kansas, while this city in the low year recorded only 3606. Similarly, Topeka with a high of 12,652 had a low of only 2521 and Oklahoma City had a range from 4108 to 11,604.

Friction Losses in Asbestos Prefabricated Ducts

PREFABRICATED ducts made of asbestos are now available in either round or rectangular cross-sections and their frictional properties have been tested at the Mellon Institute. R. H. Heilman and R. A. MacArthur reported results of these studies in a paper at the December, 1938, meeting of American Society of Refrigerating Engineers. The accompanying test and illustrations are from this paper.

Regarding the testing procedure used and the equipment for testing, the authors reported that all tests were made on ducts erected as is usual in practice. For friction losses, the cross-sections of 50- to 70-ft. lengths of duct connected to a plenum chamber fed with air from a centrifugal fan driven by a 3-hp. motor were explored with a pitot head connected to a manometer reading to 0.002 in. of water. Both static and velocity pressures were obtained with this head and gage. Velocity pressures were measured at the centers of equal areas over all duct cross-sections, and a sufficient number of readings were taken to make the data closely accurate. The distance from the plenum chamber to the first station was about 13 ft. and data presented in this paper are based on the remaining downstream leg of the ducts.

Procedure and data for friction determination were developed and illustrated as follows: "One of the objects of this investigation was to determine the static pressure drops that obtain in metal and asbestos ducts for velocities up to 3000 f.p.m. To obtain this information over a range of diameters, the drop in static pressure for a distance of approximately 40 ft. was measured on asbestos ducts of the following cross-sectional dimensions: 2½ in. x 11½ in., 4 in. x 17½ in., 8½ in. x 8½ in., and 8 in. and 12 in. round, and on round metal ducts of the diameters 6 in., 8 in., 12 in., 16 in.

Fig. 1, plotted on logarithmic paper, gives the drop in static pressure obtained on the various ducts tested. The static pressure drop corrected to a 100-ft. length is plotted against the average velocity measured at the downstream end of the duct.

Fig. 1 shows that the curves of velocity against pressure drop for the various duct sizes are parallel to each other and have a slope of approximately 1.87. This indicates that the pressure drops obtained vary directly within 1% as $V^{13/7}$.

When the pressure drops obtained on the asbestos ducts were plotted on rectangular coordinate paper against the reciprocal of 4 times the hydraulic radius it was found that a straight line could be drawn through the plotted points which had a maximum deviation of less than 8% from any of the points. The same was found to be true for the round metal ducts, although the line obtained did not fall on the line obtained for the asbestos ducts but was parallel to it.

Fig. 2 was constructed from the above relationships of velocity and diameter or hydraulic radius.

The hydraulic radius is defined as the quotient of the area divided by the perimeter of the wetted surface, or, for a rectangular duct, $R = \frac{ab}{2(a+b)}$ and for a cylindrical duct, $R = \frac{r}{2}$ or $\frac{D}{4}$. Therefore, the diameter D of a round duct $= 4R$ or 4 times the hydraulic radius.

This chart gives the pressure drop in inches of water for a 100-ft. length of asbestos duct and may be used for either rectangular or round ducts. In using the chart for rectangular ducts the pressure drop is obtained by multiplying $\frac{ab}{2(a+b)}$ by 4 and by following the line in the curve corresponding to this diameter to the point where it crosses the desired velocity line and dropping down vertically to the bottom of the scale where the pressure drop is obtained directly.

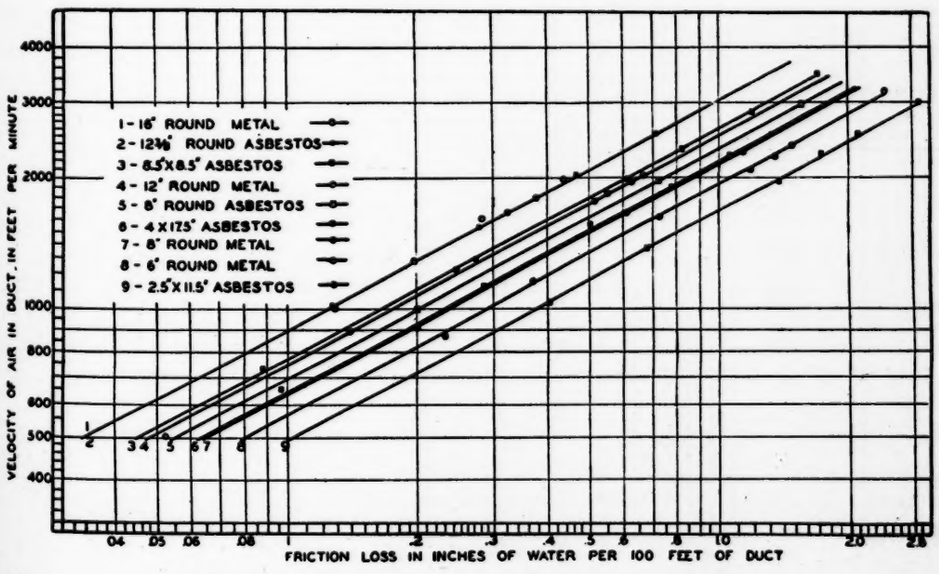

VELOCITY OF AIR IN DUCT, IN FEET PER MINUTE
4000
3000
2000
1000
800
600
500
400
1 - 16" ROUND METAL
2 - 12⅛" ROUND ASBESTOS
3 - 8.5"X8.5" ASBESTOS
4 - 12" ROUND METAL
5 - 8" ROUND ASBESTOS
6 - 4"X17.5" ASBESTOS
7 - 8" ROUND METAL
8 - 6" ROUND METAL
9 - 2.5"X11.5" ASBESTOS
.04 .05 .06 .08 1 .2 .3 .4 .5 .6 .8 1.0 2.0 2.5
FRICTION LOSS IN INCHES OF WATER PER 100 FEET OF DUCT

Fig. 1. Test relation between velocity and duct friction.

Example: Determine the pressure drop in 100 ft. of 8½ in. x 14½ in. asbestos duct when air is flowing through the duct at a velocity of 1600 f.p.m. $\frac{4(8.5 \times 14.5)}{2(8.5+14.5)} = 10.72$, which gives a pressure drop of 0.355

in. of water. The pressure drop would also be 0.355 in. for a 10.72-in. diameter asbestos round duct carrying air at a velocity of 1600 f.p.m. or a volume of 1000 c.f.m.

The chart cannot be used for round metal ducts of the usual construction owing to the fact that the frictional resistance in these ducts is somewhat higher than would be obtained by the use of the chart. On the other hand, data obtained previously on rectangular metal ducts indicate that the losses in well-made metal ducts fabricated from units six or eight feet long and joined with lock strips may be taken from the chart of Fig. 2.

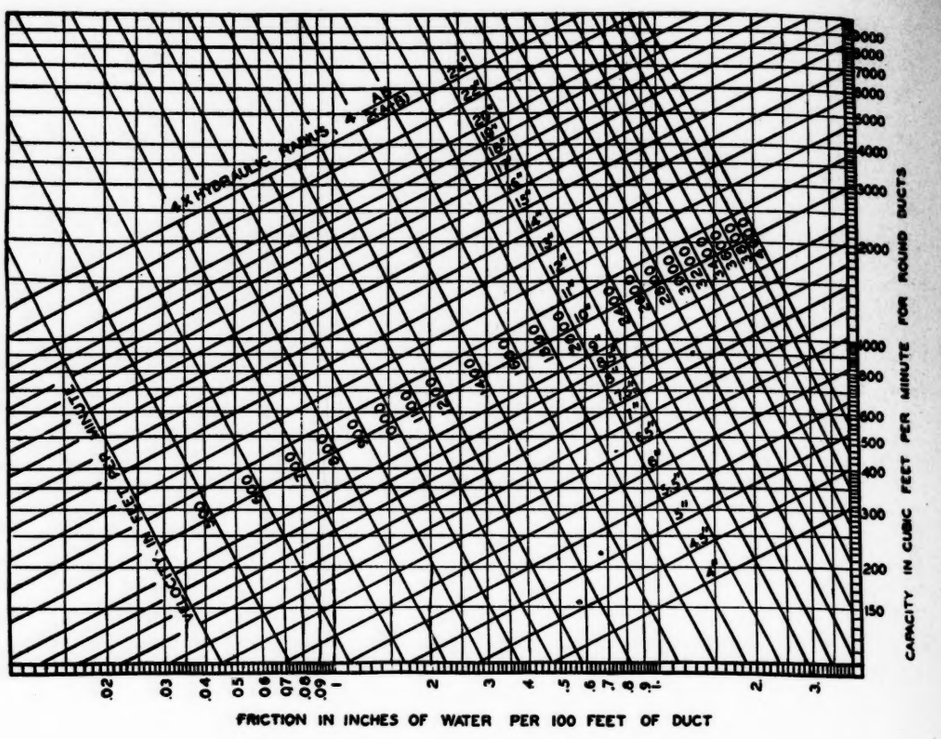

AIR HYDRAULIC RADIUS, R = A/P (FEET)
VELOCITY IN FEET PER MINUTE
CAPACITY IN CUBIC FEET PER MINUTE FOR ROUND DUCTS
FRICTION IN INCHES OF WATER PER 100 FEET OF DUCT

Fig. 2. Friction chart developed from tests.

The friction losses in elbows of various types were studied briefly. Fig 3 shows the relation between the plenum chamber static pressures necessary to drive air at the velocities given through 42 ft. of 5½ in. x 8½ in. duct including the 90° elbows indicated. Eighteen feet of the duct formed a downstream leg for the turns. Asbestos elbows are equipped with directing vanes. The two elbows had losses of about 22% of the velocity head. With the metal turn the losses are considerably higher without a downstream leg following the turn. This leg is not necessary with elbows equipped with vanes, as has been pointed out previously. The losses in ducts immediately following metal elbows may often appear to be negative. Two 8-in. round 90° elbows in series at the end of an 8-in. duct caused a loss of 212% of the velocity head. The addition of a 6-ft. length of duct on the downstream end of the turns increased the velocity from 1890 to 1930 f.p.m.; at the same time the static pressure upstream from the turns dropped 12%. At 1200 f.p.m. velocity, a 4-in. x 17½ in. asbestos 90° turn equipped with one turning vane, aspect ratio about 10, had a loss of 14% of the velocity head, this loss increasing to 18% at 2150 f.p.m. The corresponding loss in a broadway turn, effective aspect ratio about 3, was about 30%. One rather poorly made 8½ in. x 8½ in. asbestos 90° turn, effective aspect ratio about 5, had a loss of 22% at 1000 f.p.m., and 31% at 2000 f.p.m.

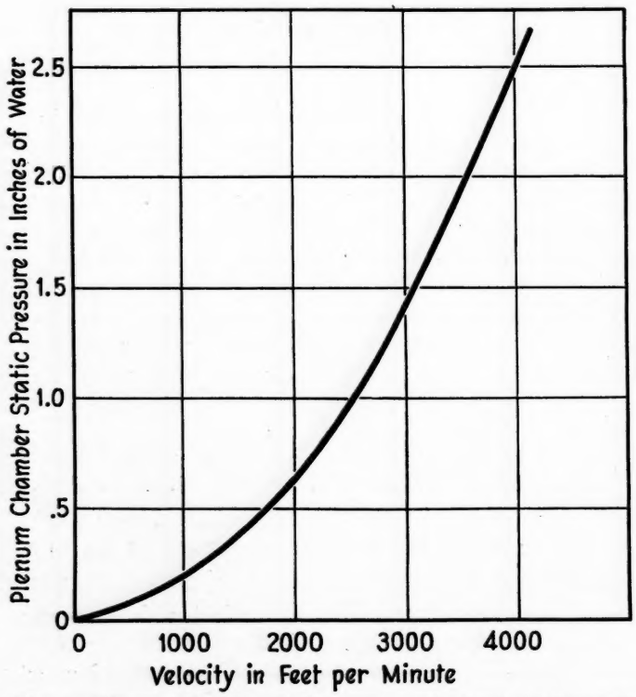


Fig. 3. Plenum chamber static pressure to feed air through 42 ft. of 5½ in. × 8½ in. duct including metal and asbestos 90° ells.

The losses in turns and fittings depend to a large extent on their environment, and the same turn may have losses varying, as it did for one turn tested, from 17 to 85% of the velocity head. It is believed that turns well downstream from obstructions or other causes of poor air distribution will always show minimum losses.

Heating a Bay for Bathers

IN San Francisco there has recently been completed a million-dollar Aquatic Park which includes a bath house and a swimming basin which is roughly a mile in circumference. An idea for heating this water has been conceived by W. A. Hansen, manager of the Aquatic Park.

Mr. Hansen's idea consists of taking the warm water which is discharged from a nearby power plant and to distribute it by a sprinkler system on the bottom of the swimming basin so that bathers can swim in comfort 365 days a year. The warm water, which has a temperature of 75 to 90F, would be piped to the swimming basin through the Fort Mason tunnel.

The Economy of Intermittent Heating

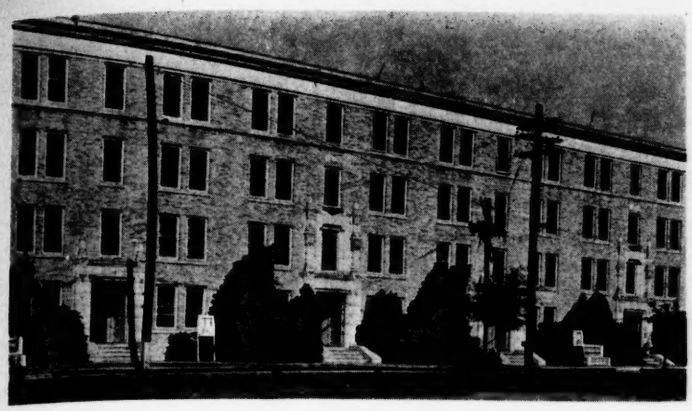


Fig. 1. College dormitory, studied for economy of intermittent heating.

By F. E. GIESECKE†

TO study the economy of intermittent heating, it is of advantage to analyze the case of some particular building. For example, let it be required to determine the economy which can be effected by interrupting the heating during a portion of the night of the four-story dormitory shown in Fig. 1 and composed of a series of units as shown in Figs. 2 and 3.

Assume that the unit represented in Figs. 2 and 3 has a heat loss of 2860 B.t.u. per degree-hour, as shown in Table 1, and a heat storage capacity of 75,000 B.t.u. per F change of indoor air temperature; i.e., that the unit will dissipate 75,000 B.t.u. when the indoor temperature is lowered 1F and that it will absorb 75,000 B.t.u. when the indoor temperature is raised 1F.

TABLE 1—HEAT LOSS OF BUILDING PER DEGREE-HOUR, B.t.u.

Walls	764
Glass	717
Roof	448
Floor	157
Infiltration	774
	2860

Assume that the unit is equipped with a heating system having a capacity of 150,000 B.t.u. per hr., based on 20F outdoor temperature, and that the indoor temperature must remain 70F from 7 a.m. until 10. p.m. It is evident that during those nights when the outdoor temperature is 20, it is not feasible to discontinue heating because the capacity of the heating system is only slightly greater than necessary to maintain an indoor temperature of 70 when the outdoor temperature is 20, but, during nights when the outdoor temperature is above 20, it is feasible to discontinue heating temporarily and to effect a saving thereby.

To determine what saving can be effected, it is necessary to determine how long the heating may be interrupted; to do this it is necessary to calculate the rate at which the building will cool when heating is interrupted and the rate at which it can be heated up after heating is resumed.

†Director, Texas Engineering Experiment Station, Agricultural and Mechanical College of Texas.

The time necessary to cool or heat a building a given number of degrees may be calculated approximately by the formula:[1]

$$X = \frac{h}{l} \times \log_e \frac{S - l\,(t_o - t_a)}{S - l\,(t - t_a)} \quad \ldots\ldots\ldots\ldots (1)$$

where

X = the required time of cooling, hours
h = the heat stored in the building and its contents, B.t.u. per F
l = the heat loss of the building in B.t.u. per hr. per F
t_o = the initial indoor air temperature, F
t = the final indoor air temperature, F
t_a = the average outdoor air temperature, F
S = the heat supplied the building in B.t.u. per hr.

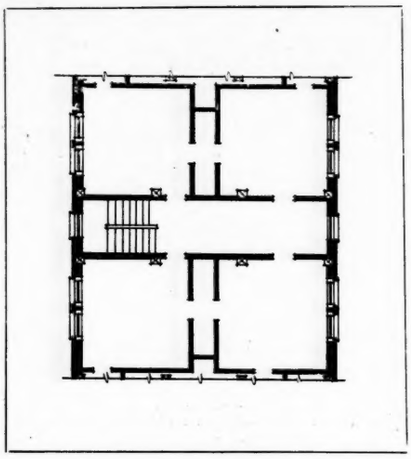
The value of l can be calculated in the usual way as shown in Table 1.

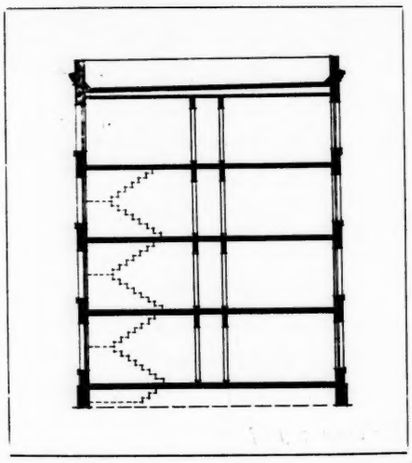
The value of h, the change in the quantity of heat stored in the building and its contents for 1F change in the temperature of the indoor air, depends on the character of the walls, floors, ceilings, and roof which constitute the building, and on the character and volume of the contents of the building.

The change of heat content of the entire building is found by adding the changes of heat content of each of the several component parts. However. the change of heat content h is not constant for any one building; it varies with the length of the time of heating and cooling, with the thickness of the walls, floors, and other elements, with the materials of which the building elements are constructed, and with the rate at which the building is heated or cooled. The value of h will be

[1]This formula was derived by H. Home in *Warme*, Oct. 17, 1931.

Usually where intermittent, or short-hour, heating is practiced, the time of closing off the heat supply and of reopening it must be found either by direct trial in the building or by experiments to measure the rate of heating and cooling. Doctor Giesecke, well known to the heating industry, shows a method whereby the time may be estimated from easily obtained information and by calculation instead of by trial or experiment. His example of applying the method to a college dormitory indicates that the saving anticipated is between 3 and 4%.





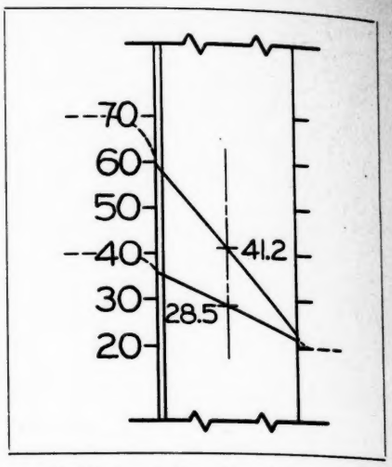


Fig. 2. (Left). Plan of one division of the dormitory. Fig. 3. (Center). Section of one division of the dormitory. Fig. 4. (Right). An approximate method of determining the cooling of an exterior wall with respect to the simultaneous cooling of the indoor air.

lower during the heating-up period than during the cooling-down period if the rate of supplying heat to the building during the heating-up period is higher than the rate at which the building loses heat during the cooling-down period. Consequently, the value of h cannot be determined as accurately as the value of l, the loss of heat of the building, and Equation (1) is only approximately correct since it is based on the assumption that the value of h is constant, which is not the case.

An approximate value of h for an outside 12-in. brick wall may be determined from Fig. 4. This illustration shows the temperature gradients in the wall when the outdoor temperature is 20 and the indoor temperatures, respectively, 70 and 40, and when these temperatures have remained constant for a sufficiently long time so that the temperature gradients are straight lines. In this case the average wall temperatures are, respectively, 41.2 and 28.5 and show that when the indoor air temperature is reduced from 70 to 40, or 30F, the average wall temperature is reduced from 41.2 to 28.5, or 12.7F, or 42% of 30F. Hence, to calculate the change of heat stored in the wall, only 42% of the weight of the wall should be used if the calculation is to be based on the change of the indoor air temperature.

In a similar manner, approximate values of h may be determined for the other elements of a building.

The resulting values will be as shown in Table 2.

The values of Table 2 are only approximate, partly because, as a rule, the temperature gradient through a wall cannot be represented by a straight line as was done in Fig. 4, and partly because these values vary with several factors as explained before.

Using the values of Table 2, calculating the weights of the several elements of the unit building, shown in Figs. 2 and 3, and tabulating the results as shown in Table 3, it appears that the value of h for this unit is 97,315.

TABLE 2—PERCENTAGES TO BE USED IN CALCULATING THE VALUE OF h, THE HEAT STORED IN THE BUILDING AND ITS CONTENTS, B.T.U. PER F

Exterior walls	42
Interior walls	80
Floor	70
Ceiling	75
Roof	20
Furniture	90

The percentages of Table 2 are sufficiently accurate when heating is interrupted for several days while the outdoor temperature remains low so that considerable cooling takes place in the building.

If the heating is interrupted for a few hours only, it is necessary to use lower percentages than those of Table 2. If a greater degree of accuracy is desired, the approximate percentages may be determined by a series of trial calculations. In that case, a beginning may be made by assuming the percentages of Table 4, and making a calculation, as indicated in Table 3, from which it will be found that the value of h is 68,182 B.t.u. or 30% less than it is according to Table 2. Reducing the value of h by 30% will, according to Equation (1), shorten by 30% the time required to cool the building a given number of degrees.

Using the value of h, 68,182 B.t.u., and applying

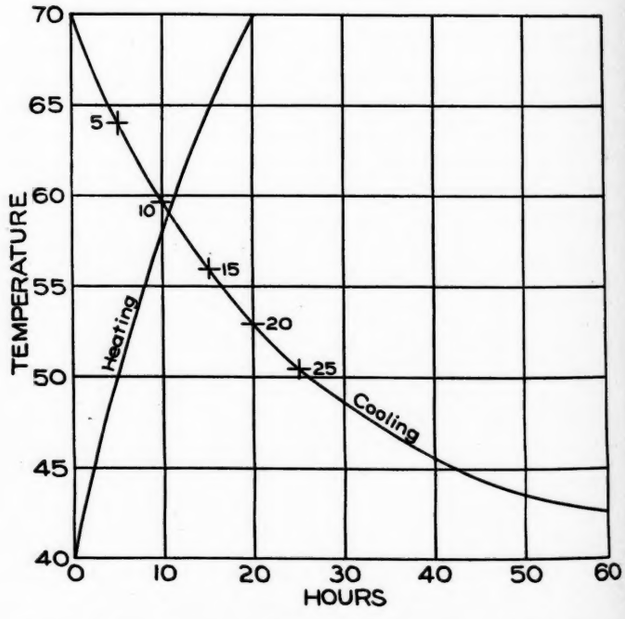


Fig. 5. Rates of cooling-down and heating-up of the indoor air for the conditions of this study.

TABLE 3—HEAT STORED IN BUILDING PER F

Construction	Total Weight	Percentage	Weight Used	Specific Heat	Heat Stored B.t.u. per F
Exterior walls	141,800	42	59,600	0.20	11,920
Floors	184,000	70	128,800	0.20	25,760
Interior walls	230,700	80	184,600	0.20	36,920
Stairs	55,300	70	38,700	0.20	7,540
Columns	91,300	70	63,900	0.20	12,780
Roof	58,870	20	11,774	0.20	2,355
Total					97,315

Equation (1), the cooling and heating curves shown in Fig. 5 are found.

Having the cooling curve of Fig. 5, a trial calculation may be made to determine the degree of accuracy of the percentages of Table 4 by constructing the diagrams of Figs. 6 and 7 which show, respectively, the rates of cooling of the 12-in. exterior brick wall and of a 12-in. interior brick wall when the indoor air is cooling according to the curve of Fig. 5. The basic principles of the method of constructing the diagrams of Figs. 6 and 7 are explained in a paper given by the writer at the January, 1939, meeting of the American Society of Heating and Ventilating Engineers.

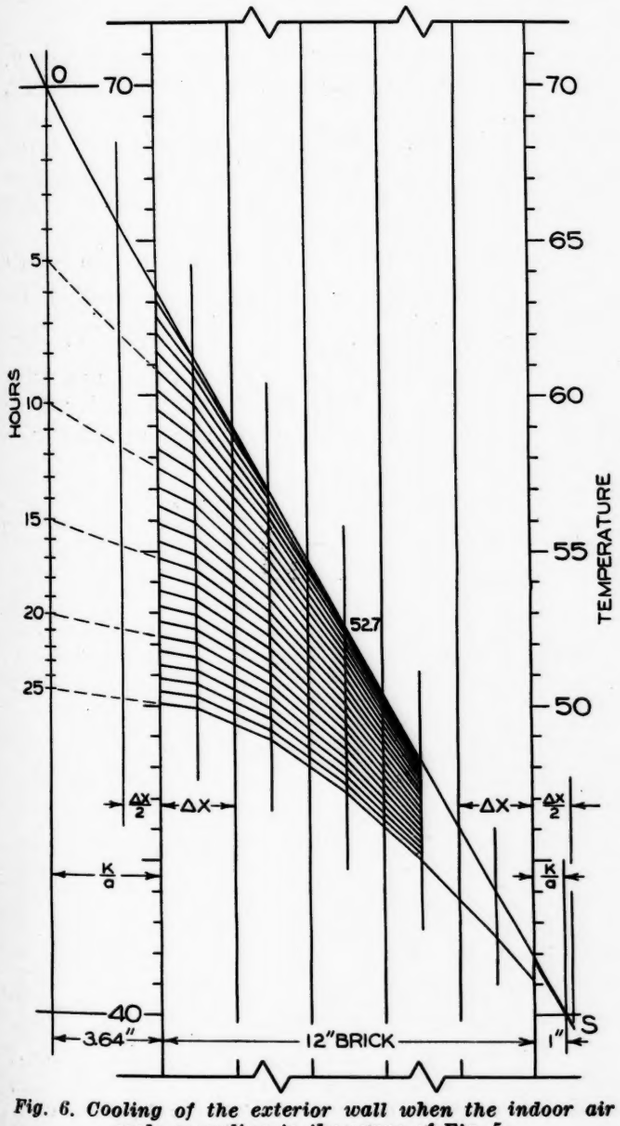


Fig. 6. Cooling of the exterior wall when the indoor air cools according to the curve of Fig. 5.

TABLE 4—PERCENTAGES TO BE USED IN CALCULATING THE VALUE OF *h*, WHEN THE TIME OF COOLING IS ONLY A FEW HOURS

Exterior walls	20
Interior walls	60
Floors	50
Ceiling	60
Roof	15
Furniture	70

In constructing Figs. 6 and 7, the time and space intervals were, respectively, 1 hr. and 2.4 in. Intervals of 1 hr. were set off along the cooling curve of Fig. 5 and the corresponding temperatures of the indoor air determined and set off in Figs. 6 and 7 to locate the successive directing points by means of which the temperature gradients in the walls were determined. Having found the series of temperature gradients, the corresponding wall temperatures were calculated. For example, at the end of the tenth hour of cooling, the average temperature of the exterior wall was 50.9; at the beginning of the cooling period its average temperature was 52.7; the total cooling in the 10-hr. period was therefore 1.8F. In the same period the indoor air had cooled from 70 to 59.7, or 10.3F. The relative cooling of the exterior wall was therefore 17½%. Similarly, the interior 12-in. wall had cooled from 70 to 66.4, or 3.6F, which is 35% of the cooling of the indoor air.

The diagrams of Figs. 6 and 7 are based on the assumption that the interior of the building had been maintained at 70F for a sufficient period of time so that the interior walls had an average temperature of 70 and so that the exterior wall had an average temperature of 52.7, as determined by the straight line gradient shown in Fig. 6.

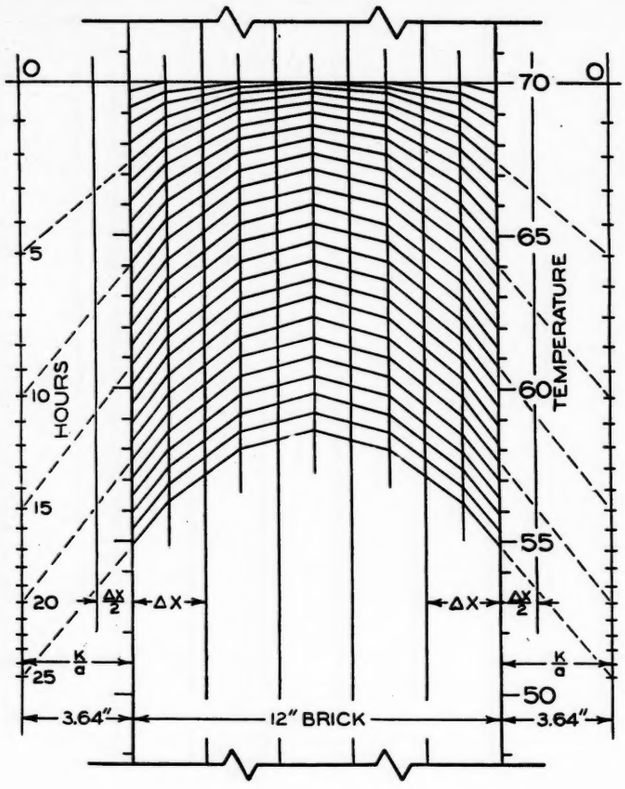
Diagrams like that of Fig. 7 were constructed for a 7.2-in. wall and for a 3.6-in. wall, except that for the latter the time and space intervals were, respectively, 15 min. and 1.2 in.

Having the cooling diagrams for the exterior wall and for three interior walls, the rates of cooling were determined at several time intervals and shown in the diagram of Fig. 8, in comparison with the rate of cooling of the indoor air, as shown in Fig. 5.

By means of data from Fig. 8, the diagram of Fig. 9 was constructed to show the percentage of cooling to be used, in calculating the value of *h* for a building; for the 12-in. exterior brick wall and for various interior brick walls, and for various periods or degrees of cooling, when the indoor air cools according to the curve of Fig. 5.

If the indoor air cools at a different rate from that shown by Fig. 5, there will be a corresponding change in the rate of cooling of the walls, floors, and the other elements of the building, and consequently also in the diagram of Fig. 9.

The rate of cooling of interior concrete walls and floors may be determined by diagrams like those of Fig. 7. It will be found that the rate of cooling of concrete walls is practically the same as that of brick walls



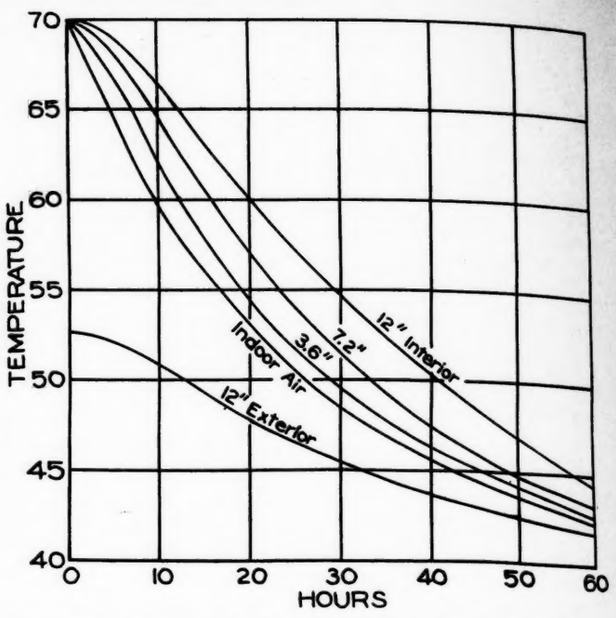


Fig. 7. (Left). Cooling of an interior 12-in. brick wall when the indoor air cools according to the curve of Fig. 5. Fig. 8. (Above). Cooling of the exterior and of three interior walls with respect to the cooling of the indoor air.

of equal thickness. This is explained by the fact that while concrete has a higher heat conductivity than brick work, it has also a higher heat storage capacity, and the two factors practically balance each other in their effect upon the cooling rate.

The values of the percentages shown for brick walls in Fig. 9 may therefore be used for concrete walls and for concrete floors of equal thickness.

An inspection of Fig. 9 shows

1. That the percentage for the exterior wall approaches 42 and the percentages for interior walls approach 100 as the time of cooling is prolonged.

2. That the percentage for the exterior wall is about 5 and that of a 4-in. interior wall about 53 if the time of cooling is 5 hr.

Since the time of cooling for the conditions assumed in this study will be about 5 hr., it is evident that the values of the percentages in Table 4 are still too high. Hence, if greater accuracy is desired it will be necessary to modify Table 4 by reducing the value of the percentage for the exterior wall from 20 to about 5, and those for the other parts of the building in accordance with the diagram of Fig. 9 and proceeding, as described above, with the preparation of new diagrams for Figs. 5, 6, 7, 8, and 9.

When this refinement is not desired, the diagram of Fig. 10 may be constructed by applying the cooling and heating curves of Fig. 5 to a chart as shown.

The point of intersection of the two curves fixes the time when heating must be resumed—2:15 a.m. in this case—and also the temperature to which the indoor air will cool—65F in this case.

The area of the triangle *a b c* of Fig. 10 shows the saving effected by interrupting the heating from 10 p.m. until 2:15 a.m. In the case under consideration, the saving is 22.1 degree-hours, or 63,206 B.t.u., if the heat loss of the building is 2860 B.t.u. per degree-hour. The cost of 63,206 B.t.u. at 50c per million B.t.u. is 3.2 cents.

This saving of 3.2 cents seems very small. However, it should be borne in mind that for indoor and outdoor temperatures of 70 and 40 there are only 30x24, or 720 degree-hours in a day and that, since the heat loss for the section of the building under consideration is only 2860 B.t.u. per degree-hour, the total heat loss is only 2,059,200 B.t.u. per day, and its cost only $1.03. A saving of 3.2 cents is therefore a little more than 3% of the cost of heating. When the cost of heating a group of buildings is about $17,500 per season, as it will be at the Texas A & M College when the buildings now

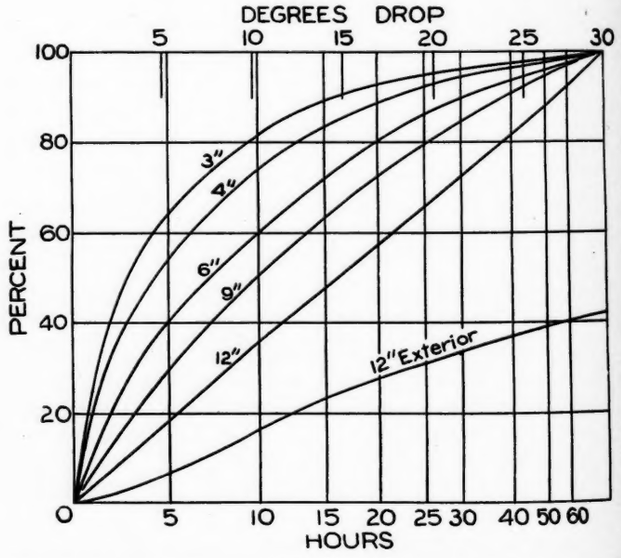


Fig. 9. Cooling of the exterior and of five interior walls, in per cent of the simultaneous cooling of the indoor air, with reference to the time of cooling and to the degree of cooling of the indoor air.

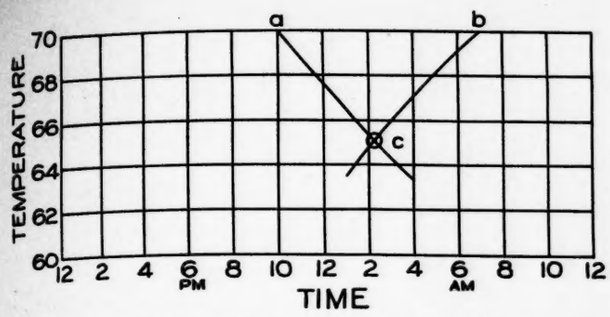


Fig. 10. Area of the triangle a, b, c, *in degree-hours, represents the saving effected by intermittent heating. The point* c *shows the temperature to which the indoor air will cool while heating is interrupted and also the time when heating must be resumed to restore the temperature of 70 at 7 a. m.*

under construction shall have been completed, a saving of 3% is worth considering. In addition, for buildings other than dormitories, heating may be discontinued earlier than 10 p.m. and the saving resulting from intermittent heating increased thereby. For example, for a classroom building having a heat loss of 18,000 B.t.u. per degree-hour, and a heat storage capacity of 878,000 B.t.u. per degree of change of indoor air temperature for a cooling period of about 6 hr., a saving of about 6½% could be effected if heating is interrupted at 6 p.m. and resumed in time to heat the building up to 70 by 8 a.m. when the average outdoor temperature is 40F.

If a second trial calculation were made, using the lower values of the percentages suggested above, the result would be to change the saving from 22.1 degree-hours to 26.1, and from 3.2 cents to 3.7 cents.

Hence, the final conclusion derived from the study is that if heating is interrupted from 10 p.m. until 2:15 a.m., when the average outdoor temperature is 40F, the saving in the cost of heating is between 3 and 4 cents per day for a section of the building containing 16 rooms.

For other buildings, other outdoor temperatures, and other periods of cooling, the possible saving resulting from intermittent heating may be calculated as outlined above.

Hot Water Heating for European Skyscraper

THE new building erected for the hotel Bel-Air Metropole in Lausanne which, with its 21 stories, is reckoned a super-skyscraper by European standards, raised special problems in heating. On the one hand, it was thought desirable not to abandon hot water heating which has always proved popular in Europe, while, on the other hand, an ordinary hot water central heating plant with cast iron boilers could not possibly be considered owing to the static pressure in the system due to the great height of the building.

The most favourable solution was found in separating the heating system for the tower from the heating system for the rest of the building, but serving both from one boiler house. The main building has a hot water central heating system connected directly to the boilers, while the tower is heated indirectly by a high pressure heat-exchanger connected to the boilers.

The heat required for the installation is produced by a battery of five cast- iron sectional boilers. In order to simplify the service as much as possible and to enable the heating system to adjust itself as rapidly as possible to suit any momentary change in the demand for heat, the boilers are equipped with semi-automatic oil firing. Each boiler can be put out of service independently from the others, and also emptied if necessary, so that the quantity of heat produced is regulated to suit the requirements not only by the oil-firing but also by putting in service merely a sufficient number of boilers to supply the heat required.

Circulation of the hot water throughout the system is ensured by two electrically-driven centrifugal pumps, the pumps being of different capacity in order that they may be adjusted to suit the requirements of the moment. The larger of the two pumps is sufficient alone for working the whole installation at the lowest outside temperature, so that the second pump serves as standby.

The whole heating installation is subdivided into separate zones, each of which can be put into or out of service from one central station according to requirements. The zones have been chosen partly in accordance with the direction which the rooms face, and partly to suit the use to which the rooms are put.

There are 12 zones—eight for heating the rooms, offices, and restaurant; three for the air-heating batteries of the ventilating plants for restaurants and cinema; and one for the heating of the tower, which, as already mentioned, is served from a heat-exchange apparatus, the hot water being circulated by a separate pump.

The offices and other rooms facing south are fitted with automatic temperature regulation, by means of which the heating of this group is put out of action when sunshine causes the temperature in the rooms to rise above a certain limit. As soon as the temperature falls, the heating is automatically put in service.

Most of the rooms are heated by radiators installed under the windows and alongside the outer walls. In the whole building there are about 1,100 radiators with a total heating surface of 44,500 sq. ft.

A hot-water supply service for lavatories, bath rooms, and kitchens is combined with the central heating plant. The service water is heated in four boilers, three of them each of 1,300 gal. capacity serving the main building and the wings, and one of 660 gal. capacity serving the tower.

How Should a Heating and Ventilating Business be Owned?

3. The Incorporated Business

By CHARLES R. ROSENBERG, Jr.†

HEATING and ventilating contractors are certainly not to be criticized for wondering, at times, whether there is any reasonably "safe" way of being in business. They see one-man businesses swept away through some personal transaction of the owner's that had nothing to do with the business. They observe members of partnerships financially ruined because of some unfortunate deal made by one of the partners, or the business wrecked when one partner dies and his executor demands an "accounting."

A contractor can manage his sales and control his overhead expense, but what can he do to protect himself against these lurking legal hazards that seem to spring from the very fact of business existence?

He can incorporate! The most urgent and earnest advice that lawyers give to both individual and partnership contractors is to consider seriously the idea of incorporating the business. The corporate form of doing business has just about everything in the way of legal and practical advantages. The officers, directors, and stockholders of a corporation cannot ordinarily be held personally liable for the debts and obligations of the corporation. This means that a contractor whose business is incorporated can legitimately keep his personal assets and affairs separate and distinct from his business. Business troubles of the corporation will not tangle his home and other personal possessions.

Two or more contractors going into business together as a corporation avoid all the legal headaches incident to a partnership. The corporation can be held liable for the acts of its officers and only to the extent of their authority. An unbusinesslike deal by a corporation officer or employe does not "bind" the corporation unless the person attempting to enforce the transaction against the corporation can prove that he had the power to make it. In partnership, a partner has full power to involve the partnership by the mere fact that he is a partner.

Death of an officer, director or stockholder of a corporation does not affect the ownership or operation of the corporation business. The only change is that the stock in the corporation is owned by the dead man's estate or heirs. The stock does not have to be bought up by the remaining stockholders unless they want to do it.

Does it pay to incorporate a local heating and ventilating business? That's something like asking whether it pays to carry fire insurance. The legal and financial perils which the corporate form of business ownership is designed to avoid may never occur; but they can happen and if they do, the incorporated contractor is prepared to meet them. A contractor just going into business for himself or two or more contractors setting up a joint enterprise should incorporate at the outset unless incorporation appears to be legally and financially impracticable. Similarly, an "individual" or partnership contractor business should be changed over to the corporate form, if at all practicable, for the protection and peace of mind of all concerned.

How much does it cost? In most cases, probably much less than contractors imagine. Legal requirements and expenses incident to organizing a corporation vary according to the statutes of the different states and, to some extent, according to the capitalization. The smaller the capitalization, the less the expense of incorporation as a rule. Sometimes it's cheaper to organize a small corporation at low cost in Delaware and then "register" as a "foreign corporation" in the state where the business is to be carried on. Delaware has very favorable corporation laws. And in most states, laws imposing heavy corporation taxes are directed for the most part at large corporations, not small ones.

Because of the tremendous legal and practical advantages of the corporate form of business ownership, it's well worth a heating and ventilating contractor's trouble to look into the practicality and expense of incorporating his business. In any event, it costs nothing to inquire—and a corporation may turn out to be just what your heating and ventilating business needs!

This concludes the author's discussion of how a business should be owned. Future articles by the author will treat various legal aspects of the contractor's business.

Incorporation shields you from lurking hazards.

†Attorney-at-Law, Media, Pa.

ABSTRACTS of Current Papers, Books and Pamphlets

Winter Air Conditioning

Professor Konzo has compiled and arranged in logical sequence an imposing array of data and useful information based not only on the test data secured at the research residence at the University of Illinois, but also on that collected from other sources. The result is a manual on the design, construction, installation, and operation of residential winter air conditioning systems.

The text is broad in its scope. The earlier chapters deal with fundamentals, including such subjects as wet and dry bulb temperatures and relative humidity, humidification requirements and limitations, and the other factors that make for comfort. Succeeding chapters take up the engineering phases of the subject, including heat loss calculations, and the several factors affecting heat loss. The author exhibits his grasp of the practical factors when he deals with dampers in duct systems, location of registers and other points on which the practical man must be well versed if he would make satisfactory installations. Several chapters contain data on such subjects as the position of registers, pressure and temperature losses, and similar subjects. Four chapters are devoted to dust design and include attention to the several methods of duct arrangement commonly used.

The author has produced what is undoubtedly the best book to appear on the subject. His arrangement of material is clear and logical, and the interpretation of test results is put into the form of a continuous and integral statement. It should do much to clear up existing confusion and difficulty in fitting the research findings into practical applications, and should appeal to all interested in forced warm air heating.

[*"Winter Air Conditioning: Forced Warm Air Heating," by S. Konzo. Published by the National Warm Air Heating and Air Conditioning Association, 50 West Broad St., Columbus, Ohio. Cloth bound, 532 pages, 6 x 9 in.; price, $3.*]

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Refrigerating Equipment Systems

The first of a new series of equipment and application standards for refrigeration machinery has been brought out by the Refrigerating Machinery Association. The purpose of these standards will be to furnish a helpful guide to both manufacturers and purchasers of refrigerating machinery. The Association points out that particular care has been taken to avoid recommendations which might tend to stultify initiative in developing advances in the art of refrigeration.

Parts I and II of the standards are included in this paper. Part I deals principally with ammonia equipment and presents information on enclosed ammonia compressors; vertical open shell and tube ammonia condensers; horizontal closed shell and tube ammonia condensers; horizontal closed ammonia shell and tube brine coolers (flooded); submerged open ammonia brine coolers; ammonia liquid receivers; ammonia mains; steel and wrought iron pipe; and cold storage room insulation.

Part II gives information on low pressure condensing units; Freon-12 condensers; and Freon-12 water coolers.

[*"Equipment Standards," Parts I and II. Published by Refrigerating Machinery Association, Southern Bldg., Washington, D. C. Paper cover; 8½ x 11 in.; 27 pages; price, 50 cents.*]

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Building Materials and Structures

These reports are part of a series issued by the National Bureau of Standards on the structural properties of construction intended for low-cost houses and apartments. Practically all of these constructions were sponsored by groups within the building industry which advocate and promote the use of such construction and which have built and submitted specimens to the Bureau. In these reports the National Bureau of Standards does not approve a construction or express any opinion as to the merits of construction. The technical facts given are intended to provide basic data from which engineers and architects can determine whether the construction meets the desired performance requirements. The bulletins recently issued include BMS9 on the structural properties of frameless-steel constructions for walls, partitions, floors, and roofs; BMS5, structural properties of six masonry wall constructions; BMS8, methods of investigation of surface treatment for corrosion protection of steel; BMS7, water permeability of masonry walls; and BMS6, survey of roofing materials in the southeastern states.

[*"Building Materials and Structures Reports," numbered as above. Published by the National Bureau of Standards, United States Department of Commerce, Washington, D. C. All paper covered, 8½ x 11 in. For sale by the Superintendent of Documents. Price, 10 cents each except Reports BMS5 an BMS6 which are 15 cents each.*]

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Cooling a Residence with Water

The University of Illinois has published another of its bulletins on cooling the Research Residence, the latest being devoted to the work carried on in the summers of 1935 and '36 using cold water. The first year's work utilized water at 58F to 60F, supplemented by air circulated at night, while the second year's investigation was undertaken to determine operating characteristics when water at temperatures of 46 and 52F was supplied to the cooling coil.

The bulletin summarizes the advantages and disadvantages of cooling with water; among the former are the simplicity, low operating cost, quietness of operation, use of rejected water for sprinkling the lawn, and the fact that no additional heat from the operation of the cooling unit is added to the building heat load.

(Continued on next page)

Among the disadvantages the authors enumerated are the fact that abundant water supply must be available at less than 60F, possible limitations on quantity of cooling water allowed by local restrictions, the high relative humidities accompanying high mean coil temperatures, large amount of coil surface required, high resistance of cooling coil requiring a powerful fan, and reduction of water pressure in service lines due to the quantity being used for cooling.

Among the conclusions reached by the authors are the following:

Using water from the city mains at 58F, it is possible to maintain an indoor dry bulb temperature of 80F, with the outdoor temperature as high as 100F. On days when the maximum outdoor temperature exceeds 90F the plant will operate continuously over considerable periods of time, and it is possible to maintain an indoor relative humidity of 63%, with a resultant effective temperature of 75F. While not representative of optimum comfort, these conditions do represent a material improvement in atmospheric conditions that would probably be acceptable to the majority of users.

On days when the maximum temperature does not exceed 90F it is possible to operate the plant with 58F water from the city mains so as to maintain effective temperatures not exceeding 74F with indoor relative humidities ranging from 70 to 80%, and to maintain acceptable conditions from the standpoint of comfort.

With 58F water from the city mains it is possible to obtain sufficient dehumidification to maintain 63% relative humidity indoors. These results indicate that 60F is probably the upper practical limit for the temperature of the available cooling water unless an excessive amount of coil surface is used, in order to maintain indoor dry bulb temperatures as low as 75F in severe weather.

Using water at temperatures of 52F and 46F it is possible to maintain an indoor dry bulb temperature of approximately 80F with the outdoor temperature as high as 108F. On days when the maximum outdoor temperature exceeds 90F the plant will operate continuously over considerable periods of time and it is possible to maintain an indoor relative humidity of 52%, with a resultant effective temperature of approximately 74F, which would undoubtedly be acceptable to the majority of users.

During intermittent operation of the cooling plant the indoor relative humidity rises to a maximum during the *off*-period. The magnitude of this rise is dependent to a great extent on the moisture content of the outdoor air.

During continuous operation of the cooling plant the indoor relative humidity decreases to a minimum value which is independent of the moisture content of the outdoor air, and is related to the mean coil temperature.

With the rates for water and electricity prevailing in Urbana, Ill., the operating costs of a plant using water as a primary cooling medium are not unreasonable.

[*"Summer Cooling in the Warm-Air Heating Research Residence with Cold Water," University of Illinois Bulletin No. 305, by A. P. Kratz, S. Konzo, M. K. Fahnestock, and E. L. Broderick. Size 6 x 9 in.; 92 pages. Published by the University of Illinois Engineering Experiment Station, Urbana, Ill.; price, 90 cents.*]

BRIEF REVIEWS

WARM AIR HEATING. New editions of the various codes dealing with warm air heating and prepared by the National Warm Air Heating and Air Conditioning Association. [*"The Standard Gravity Code for the Design and Installation of Gravity Warm Air Heating Systems," 10th Edition; 8 pages; price, 25 cents. "The Practical Code for the Design and Installation of Mechanical Warm Air Heating Systems for Small Installations," 4th Edition; 8 pages; price, 25 cents. "The Technical Code for the Design and Installation of Mechanical Warm Air Heating Systems," 2nd Edition; 16 pages; price, 50 cents. All codes published by the National Warm Air Heating and Air Conditioning Association, 50 W. Broad St., Columbus, Ohio. All paper bound; 8½ x 11 in.; punched for loose-leaf binders.*]

COAL COMBUSTION. An analysis and observation of coal fires with the object of determining the condition of the fire. [*"How Would You Read a Fire?", by T. A. Marsh. Published in the Southern Power Journal, Grant Bldg., Atlanta, Ga., February, 1938, pages 47 to 49.*]

LOW TEMPERATURE AIR CONDITIONING. Low temperature air is used extensively in the development and testing of aircraft engines and their accessories. This paper describes the uses of low temperatures in aircraft engine testing laboratories and gives information on the type of air conditioning systems employed to produce these temperatures. [*"Air Conditioning at Low Temperatures in Aircraft Engine Laboratories," by John R. Monsell. Paper presented before the 34th annual meeting of the ASRE, New York, Dec., 7, 1938.*]

FURNACES. A comparative study of the performance of stoker-fired and hand-fired warm air furnaces conducted at the research residence in Urbana. [*"Performance of Stoker-Fired and Hand-Fired Warm-Air Furnaces in the Research Residence," by A. P. Kratz, S. Konzo, and R. B. Engdahl. ASHVE paper*. Abstracted on page 28 of this issue.*]

INDUSTRIAL AIR CONDITIONING. An ASHVE research laboratory study of physiological reactions on individual workers to high effective temperatures. [*"Air Conditioning in Industry," by W. L. Fleisher, A. E. Stacey, Jr., F. C. Houghten, and M. B. Ferderber. ASHVE paper*. Abstracted on page 25 of this issue.*]

SMOKE. A statement of the smoke situation in American cities and a discussion of what is to be done about it by the director of the Air Hygiene Foundation of America, Inc. [*"Smoke Abatement—Where to Draw the Line," by H. B. Meller. ASHVE paper.*]

HEAT TRANSFER. A paper giving the results of tests made to determine the capacities and heat transfer coefficients in the common type of horizontal storage water heaters. [*"Heat Transfer in Storage Water Heaters," by D. W. Nelson and A. A. Rosenberg. ASHVE paper*. Abstracted on page 27 of this issue.*]

*Papers marked (*) were presented at the 45th annual meeting of the ASHVE. Requests for reprints should be addressed to the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York.

AIR FRICTION. A report on the study of air friction in straight ducts made at the ASHVE research laboratory. [*"Frictional Resistance to the Flow of Air in Straight Ducts," by F. C. Houghten, J. B. Schmieler, J. A. Zalovcik, and N. Ivanovic. ASHVE paper*. Abstracted on page 29 of this issue.*]

COAL PERFORMANCE. Suggestions by the supervising fuel engineer of the U. S. Bureau of Mines, on points to consider when selecting solid fuels for small heating plants. [*"Selection of Solid Fuels from the Viewpoint of the Small Consumer," by P. Nicholls. ASHVE paper*. Abstracted on page 28 of this issue.*]

HEAT FLOW. A mathematical analysis of heat flow through building walls together with results of an experimental study. [*"The Flow of Heat Through Walls," by F. E. Giesecke. ASHVE paper*. Abstracted on page 29 of this issue.*]

COAL. A study of the smoke-producing tendencies of the different types of coal. [*"Smoke-Producing Tendencies in Coals of Various Ranks," by H. J. Rose and F. P. Lasseter. ASHVE paper*. Abstracted on page 28 of this issue.*]

HEAT DISSIPATION. The results of work done at The Mayo Clinic in showing the part played by the fingers and toes in dissipating heat from the body. [*"The Role of the Extremities in the Dissipation of Heat from the Body in Various Atmospheric and Physiological Conditions," by Charles Sheard, Marvin M. D. Williams, Grace M. Roth, and Bayard T. Horton. ASHVE paper*. Abstracted on page 26 of this issue.*]

ALUMINUM. A study of aluminum as used for a thermal insulation. [*"Some Reflection and Radiation Characteristics of Aluminum," by Cyril S. Taylor and Junius D. Edwards. ASHVE paper*. Abstracted on page 27 of this issue.*]

FILTERS. A report of a study of filter performance and how it is affected by different types of dust, from a study conducted at the University of Minnesota. [*"Air Filter Performance as Affected by Low Rate of Dust Feed, Various Types of Carbon, and Dust Particle Size and Density," by Frank B. Rowley and Richard C. Jordan. ASHVE paper*. Abstracted on page 25 of this issue.*]

HOSPITAL CONDITIONING. Reports of the results of a research investigation into the heating and air conditioning rooms of various hospital departments. [*"Air Conditioning Requirements of an Operating Room and Recovery Ward," by F. C. Houghten and W. L. Cook, Jr. ASHVE paper*. Abstracted on page 26 of this issue.*]

BLOOD FLOW. The report of research carried on at the University of Illinois department of medicine, to determine the effect of varying air temperatures on the flow of blood in the human being. [*"Cardiac Output, Peripheral Blood Flow, and Blood Volume Changes in Normal Individuals Subjected to Varying Environmetal Temperatures," by Ford K. Hick, Robert W. Keeton, Nathaniel Glickman, and Harry C. Wall. ASHVE paper*. Abstracted on page 26 of this issue.*]

MOISTURE IN WALLS. This paper gives some of the results obtained during the past year in research conducted to determine the cause of condensation within buildings, its extent under various conditions, and methods of preventing and correcting such condensation. [*"Condensation of Moisture and Its Relation to Building Construction and Operation," by F. B. Rowley, A. B. Algren, and C. E. Lund. ASHVE paper*. Abstracted on page 27 of this issue.*]

GLASS. A comparison of a study to determine the heat necessary to maintain a given temperature in two similar houses, one with single windows, the other with double windows. [*"A Study of the Heat Requirements of a Single-Glazed Test House and a Double-Glazed Test House," by M. L. Carr, R. A. Miller, and David Shore. ASHVE paper*. Abstracted on page 27 of this issue.*]

SKIN TEMPERATURES. The authors of this paper have shown that in the zone of body cooling dissipation of heat from the body is dependent on the temperature of the environment. [*"Skin Temperatures of the Extremities and Effective Temperature," by Charles Sheard, Marvin M. D. Williams, and Bayard T. Horton. ASHVE paper*. Abstracted on page 26 of this issue.*]

HEAT FLOW. A method for calculating the flow of heat into a building and how it is affected by outdoor temperature and insolation. [*"The Effect of Heat Storage and the Variation in Outdoor and Solar Intensity on the Heat Transfer Through Walls," by J. S. Alford, J. E. Ryan, and F. O. Urban. ASHVE paper*. Abstracted on page 29 of this issue.*]

VENTILATION. A report of the ASHVE research technical advisory committee on physiological reactions. [*"Recent Advances in Physiological Knowledge and Their Bearing on Ventilation Practice," by C.-E. A. Winslow, T. Bedford, E. F. DuBois, R. W. Keeton, A. Missenard, R. R. Sayers, and C. Tasker. ASHVE paper*. Abstracted on page 26 of this issue.*]

WEATHER DATA. An analysis of summer wet bulb, dry bulb, and dewpoint temperatures, together with data on summer sunshine and wind, maps and tables. [*"Analysis of Summer Weather Data in the United States," by J. C. Albright. ASHVE paper*. Abstracted on page 29 of this issue.*]

WEATHER DATA. Suggestions on the application of data found in the preceding paper. [*"Application of Summer Weather Data in Design," by John Everetts, Jr. ASHVE paper*. Abstracted on page 29 of this issue.*]

OPTIMUM TEMPERATURES. The reports of a study to determine the most desirable air conditions for comfort in San Antonio. [*"Reactions of Office Workers to Air Conditioning in South Texas," by A. J. Rummel, F. E. Giesecke, W. H. Badgett, and A. T. Moses. ASHVE paper*. Abstracted on page 25 of this issue.*]

STOKERS. A study of small stokers in two parts, one devoted to domestic anthracite burners, the other devoted to small bituminous coal burning stokers. [*"Small Stokers," by Paul A. Mulcey and Ralph A. Sherman. ASHVE paper*. Abstracted on page 28 of this issue.*]

*Papers marked (*) were presented at the 45th annual meeting of the ASHVE. Requests for reprints should be addressed to the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York.

EDITORIALS

Insured Modernizing Loans

The provision of the law which permits FHA to insure modernizing loans is due to expire this spring. Present indications are that if there is any demand at all for its renewal this feature of the act will be extended with little opposition. In the time that the insured modernizing loans have been available they have been widely used. There is little doubt but that modernizing activities under the insurance feature were largely responsible for the lift which the building industry received in 1934 when it began to show its first substantial move out of the depression depths. Since the early impetus the rate at which these loans are made has shrunk but there is still a considerable volume. The principle seems well established, the experience has been generally good. There is no reason to believe but that time payment for many items of heating and cooling equipment is going to be with us for a long period. Whether government insurance is vital in making these operations successful is not known, but at any rate there is no necessity for removing the insurance feature now that it has proved itself so well.

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Research Increasingly Important

Occurrence this year of the twentieth anniversary of the establishment of the ASHVE research activities serves to call to mind the increasing importance being attached to research in this industry. We now have scarcely an up and coming business which does not devote at least some conscious effort to a study of its problems and to a stock-taking to see what can be done now to improve future prospects.

In the last analysis this study and stock-taking are what research really consists of. Elaborate staffs, huge laboratories, and all the other usual fixings are not the true measure of either the value or the effectiveness of research work. All these appurtenances do is to increase slightly the chances of success, perhaps make the effort more a conscious one, give it some added promotional and sales features, and frequently build up a fixed overhead out of all proportion to their immediate values.

The large and wealthy business can amply afford the early expense and can stand the fixed costs over that period which usually must elapse between the beginning of a long-term research program and the appearance of returns from it. The small, struggling business can not afford such costs.

This does not mean that the small business has to be without a research program. Surprisingly, many opportunities and facilities are now available in the form of cooperative efforts with others, including educational institutions, the endowed research institutes, trade associations, and technical groups. Such a program can be used to supplement those research activities which the small firm can afford to carry out independently on its own resources. The successful research program of the warm air group at the University of Illinois is a case of this kind of effort.

We now have in this industry a variety of private research laboratories at factories; cooperative projects at colleges, at the endowed institutes, at subscription laboratories, and supported by all kinds of interested groups. Then, too, we have a number of privately-owned research houses, experimental installations under test and observation, an endowed laboratory at a university. A number of the land-grant institutions have their own programs at their experiment stations. All the major fuel groups have both research and equipment testing programs under way. For some time the government, through the Bureau of Mines, has contributed toward the support of the ASHVE laboratory. During the past year the Bureau of Standards has engaged in studies whose results will affect this industry as will also results of studies at the Forest Products Laboratory.

In spite of all this impressive list it is doubtful if this industry spends as much of its total income on research in all its forms, in all its locations and in all its ramifications, as does industry in general. Estimates place current research expenditures of all industry at one per cent of its total income. This is a small percentage for an activity which has so well demonstrated its ability to produce returns when able to function under suitable conditions.

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Cooling for Hospitals

One of the encouraging signs of late is the way that a number of new hospitals have included air cooled patient rooms in their plans. Several hospitals should soon be in service with enough of their patient rooms cooled and with a wide enough variation in the climate of the cities in which they are located so that the real value to patients of cooled rooms can be studied. Results from early hospital installations have indicated already that at least in some circumstances cooled rooms are a definitely helpful factor in convalescence following some surgical operations; and in cases of heat prostration and certain other illnesses. From its conception the thought has persisted that air cooling could be made a real boon to sufferers from many illnesses but proof has been lacking, in fact impossible to get, until hospitals could be persuaded to adopt it. During recent years hospitals generally have been too hard pressed and have had too small funds to permit them to do much air conditioning. Now that a few have been able to go the whole way there is little doubt that we shall soon see air cooling equipment put into hospital rooms in the warmer cities at least with no more hesitancy than is shown in putting in good comfortable beds.

NEWS OF THE MONTH

Associations Organize to Standardize Stoker Practice; Combustion Space Requirements to be Studied

CHICAGO — Faced with a growing problem of establishing uniform and reasonable recommendations and practices covering combustion space requirements for bituminous coal and boilers when fired with underfeed stokers, five national associations have organized to conduct a field survey of 100 actual installations in the midwest in order to obtain data upon which combustion space requirements can be based.

A committee has been appointed by these associations, and Battelle Memorial Institute engaged to conduct the field study. In addition to this work, individual stoker companies will collect information through their dealers.

The associations sponsoring the investigation are the Stoker Manufacturers Association; Steel Heating Boiler Institute; Institute of Boiler and Radiator Manufacturers; National Coal Association, and National Smoke Prevention Association. The field survey will be conducted in Cincinnati, St. Louis, Chicago, and Columbus and will be under the direction of Ralph A. Sherman of Battelle.

Stoker and bituminous coal industries favor higher heat release values so that their products will not be penalized by the requirements of extensive and sometimes impossible changes. Boiler and furnace manufacturers are concerned in determining what the combustion requirements are so that their products can be designed to meet them. Those interested in smoke prevention, on the other hand, lean to the lower values of heat releases so that they may be certain of proper operation after installation.

A number of years ago recommended standards on combustion space were established by the Midwest Stoker Association and later adopted nationally by the Stoker Manufacturers Association. Since then there have been great strides made in the art of bituminous underfeed stoker firing in boilers of all types and sizes, and these standards are now somewhat dated. In 1933 a project was organized by the ASME to bring together all of the various elements concerned with this program and this was finally organized into a sectional committee under ASA procedure. This work has not progressed satisfactorily because of the lack of authoritative and unbiased data.

In the meantime, smoke inspectors, wishing more effectively to regulate the installation of stokers in various types and sizes of boilers, have placed their individual interpretations on setting heights requirements and maximum heat release requirements and in many instances they adopted central station rules to small units in limiting heat releases in order to prevent objectionable smoke. Leading manufacturers of stokers and boilers and coal operators have felt that such requirements placed restrictions on installations to the point where it actually prohibited, because of the high additional cost necessary, installation of stoker equipment, especially in territories and areas where competition with oil and gas was especially keen. All of this has resulted in various conferences and meetings between the representatives of several leading organizations in the heating industry within the past several months.

Members of the steering committee supervising this work are: C. E. Bronson, chief engineer, Kewanee Boiler Corporation, representing Steel Heating Boiler Institute; John P. Magos, directing engineer, research laboratories, Crane Company, representing Institute of Boiler and Radiator Manufacturers; C. A. Reed, director, engineering department, National Coal Association, representing that Association; William M. Culbert, chief smoke inspector, City of Nashville, Tenn., and president of the Smoke Prevention Association, and Frank Chambers, chief smoke inspector, City of Chicago, both representing the Smoke Inspectors of America; E. C. Webb, engineering service manager, Iron Fireman Manufacturing Company and B. M. Guthrie, chief engineer, stoker division, Fairbanks, Morse & Company, both representing the Stoker Manufacturers' Association.

In addition to the above representatives of the various participating organizations, Mr. Sherman, chief fuel engineer of Battelle Memorial Institute, is a member of the steering committee, while Marc G. Bluth, executive secretary of the Committee of Ten, and secretary of the Stoker Manufacturers' Association, is secretary of this special committee.

Keyes Predicts Cooled Power Lines

BOSTON—Future use of refrigerated electric power lines with temperatures near absolute zero in order to overcome power losses in long distance transmission, was predicted January 15 at M.I.T. by Dr. Frederick G. Keyes, head of the Institute chemistry department. At absolute zero metals lose their electrical resistance so that there should be little loss of energy when an electric current flows through a line at very low temperatures.

Burner Group Adopts Standards at New York Meeting

NEW YORK—The second half of the standards program recommended by the Oil Burner Institute standards committee was adopted in January at a meeting of representatives of 53 companies, representing 85% of the volume of the industry, held at the Hotel New Yorker.

The new schedule covers the broadening of manufacturers' guarantees to include compliance with specifications, and provision for production and performance tests on oil burners. The first half of the program was adopted by the industry at a meeting held in November. The standards work was undertaken at the request of FHA.

R. M. Sherman, Silent Glow Oil Burner Company, chairman of the standards committee, revealed details of the new rulings issued by the technical division of FHA covering mechanical draft oil burners, which apply to all new construction after February 1 in the New York City, White Plains, and Jamaica insuring offices.

The rulings, issued by Howard P. Vermilyea, director of the technical division, cover six major points—equipment, installation, service, adjustment, tests, and certification.

Mr. Sherman pointed out that the test provision called for a higher percentage of carbon dioxide. This provision reads as follows:

"Performance of the oil burner shall be considered acceptable when the test indicates that the per cent by volume of carbon dioxide in the flue gases is not less than 8% for firing rates of 1 gal. or less and not less than 9% for firing rates of more than 1 gal."

The service provision calls for a written guarantee for one year, with service during the heating season to be available 24 hr. a day.

Mr. Sherman, who was tendered a vote of thanks for his services as chairman of the standards committee, said that the coal and gas industries were watching the development of standards work in connection with oil burners and were planning to set up committees to do a similar job.

He added that FHA has requested the creation of local committees to act in advisory capacity. Asserting that the "strength of the whole program depends upon strong dealer organizations," Mr. Sherman urged the "revitalization of dealer organizations." The committees sought by the FHA, he said, would be a factor in creating this dealer strength.

F. H. Dewey of the air conditioning division of Gar Wood Industries and head of the Oil Burner Institute, presided at the meeting.

Oregon Sponsors A.C. Conference

CORVALLIS, OREG.—The department of mechanical engineering of Oregon State College in cooperation with manufacturers, has scheduled the Second Oregon State Air Conditioning Conference March 23-25. Latest developments in air conditioning equipment and their proper application will be discussed and, in addition, equipment will be exhibited.

Included on the program are the following: Trends in Air Conditioning; a Symposium on Air Conditioning, covering Principles of Selling, Estimating Central Plants, Estimating Sheet Metal Work, and Estimating Furnace Installation; Air Conditioning for Health and Comfort; Types of Heating Systems; Combustion; Cooling Loads and Methods; Design of Air Systems; Tests for Combustion and Efficiency; Temperature and Humidity Control; and a Symposium on Trouble Shooting covering Warm Air Systems, Steam Systems, Refrigeration, Stokers and Oil and Gas Burners.

J. Donald Kroeker, consulting engineer in Portland, Oreg., is chairman of the program committee. For further information address Prof. E. C. Willey, Oregon State College, Corvallis, Oreg.

Kurth Addresses Boston ASHVE

CAMBRIDGE, MASS.—Members of the ASHVE Massachusetts chapter, held their monthly meeting at Walker Memorial, Massachusetts Institute of Technology, January 17. F. T. Kurth, vice-president of the Anemostat Corporation of America, was the speaker, and his subject was "Air Distribution and Diffusion."

The lecture consisted of the underlying theories of air flow, distribution and prevention of drafts. A demonstration was given, using a model apparatus with eucalyptus smoke.

Committees Appointed by AGA

NEW YORK—Under the leadership of H. G. Schaul, chairman, the House-Heating and Air Conditioning Committee of the commercial section, American Gas Association, has planned a comprehensive program of activities including a study of sales plans and policies and engineering developments.

The work of the general committee on house-heating has been divided into sub-committees under the following chairmen:

New Homes—H. R. Carlson, Hartford Gas Co., Hartford, Conn.

Engineering Developments—D. S. Reynolds, Boston Consolidated Gas Co., Boston, Mass.

Improved Selling Practices—H. P. Morehouse, Public Service Electric and Gas Co., Newark, N. J.

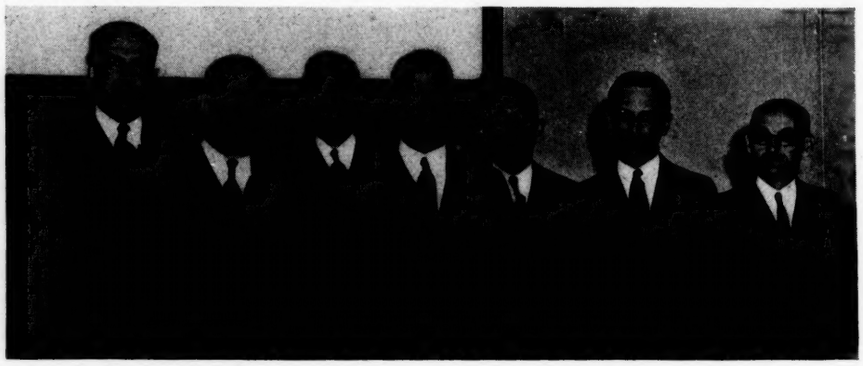
National House Heating Sales Contest—R. A. Malony, Bridgeport Gas Light Co., Bridgeport, Conn.

Domestic Direct Heating—S. L. Drumm, New Orleans Public Service Inc., New Orleans, La.

Home Loan Board Issues Report

WASHINGTON—In its sixth annual report, recently presented to Congress, the Federal Home Loan Bank board urges the elimination of labor's jurisdictional disputes and advises a revision of building industry practices so as to "give the home buyer more value for his dollar." The report states that these are the prime essentials for a solution of the chief housing problems in the United States.

The report covers the fiscal year 1937-38. It presents suggestions for a reduction in the present taxes on homes and a modification of "wasteful" foreclosure laws. A "revision of real estates taxes," the board states, "would be a desirable incentive for the revival of private building activity."



FUEL ENGINEERS AT CONFERENCE

These speakers participated in the 24th fuel engineering conference of Appalachian Coals, Inc., held recently at Kalamazoo, Mich., and attended by 326 persons. Left to right: J. E. Tobey, manager, fuel engineering division, Appalachian Coals, Inc., who presided; Frank E. McAllister, vice-mayor of Kalamazoo; E. C. Webb, engineering service manager, Iron Fireman Manufacturing Company; E. G. Bailey, vice-president, The Babcock & Wilcox Company; G. G. Zimmerman, test engineer, Indiana Service Corporation; H. L. Solberg, professor of mechanical engineering, Purdue University; and J. F. Barkley, supervising engineer, fuel economy service, U. S. Bureau of Mines.

Million Dollar A.C. Plant for duPont

WILMINGTON, DEL.—Air conditioning of the duPont Building here at a cost exceeding a million dollars, was begun January 23. The job comprises almost 400,000 sq. ft. of floor space and will provide all-season temperature and humidity control for all of the block-square 13-story structure, excepting the ground floor, theater, and hotel.

The hotel's main dining rooms and a large part of the ground floor of the office building are already air conditioned. The theater is closed in summer.

Refrigerating equipment with a total capacity of 1200 tons will be located in the basement. Cold water will be conveyed to 42 multi-unit conditioners. Ducts located in corridors and concealed by false ceilings will carry the conditioned air to offices. Present awnings and window shades are to be replaced with Venetian blinds.

Seven months are scheduled for the work, which is being handled mainly by local contractors under the general supervision of the company's engineering department.

Doctors Address Illinois Chapter

CHICAGO—Dr. R. W. Keeton, head of the Department of Medicine, University of Illinois, and Dr. F. K. Hick, also of the Department of Medicine at that University, were the speakers of the evening at the December meeting of the ASHVE Illinois chapter, December 12. The speakers, who are directors of the research cooperatively sustained by the ASHVE and the University of Illinois at the Research Hospital, spoke on the environmental factors in air conditioning as regards human heat mechanisms. They described the generation of heat by the muscles, liver, viscera, and heart; its transfer by blood flow to the body surface and the lungs; its liberation through latent and sensible means; and the physiological reaction of unbalanced heat losses.

Housing Act May be Amended

WASHINGTON—Senator Wagner and Representative Steagall will sponsor legislation in Congress to amend the National Housing Act to extend the provisions expiring July 1 for two years more, according to reports.

The amendments cover mortgage insurance on modernization and repairs and on new construction of certain types up to $2,500 in value under Title I of the act. Under Title II the distinctions between old and new construction would be eliminated and the amount of mortgage insurance which the FHA might place would be increased from $3 billion to $6 billion.

Unless amended, the statute would make it impossible for the FHA after July 1 to insure loans on homes built before 1937.

$350 Million in FHA Business for Heating and Plumbing Industry

WASHINGTON—The plumbing and heating industries have been major beneficiaries of business generated by the Federal Housing Administration's loan insurance program, according to FHA officials. They estimate that about $350 million of the $2.2 billion of insured financing on FHA books has been spent for heating and plumbing.

Conceding the difficulty of estimating exactly what part plumbing and heating has had in these activities, FHA officials point out that various analyses conducted by the FHA afford a reasonably competent yardstick for measuring the participation of various industries in the program.

For example, FHA officials say, technical analyses made by experts in the small home mortgage field have shown a varying participation for plumbing and heating, but the average participation for this industry ranged from 22% of the total cost of the house to 18% when calculated on the cost of the whole property. Therefore, on an average basis of 20%, plumbing and heating has participated to the extent of $160 million out of $1.4 billion of mortgages insured by the FHA in the small homes field, of which $800 million have been on new homes.

Furthermore, surveys conducted by the Administration's large scale housing staff have found that approximately 17% of expenditures in this program very consistently go to the plumbing and heating industry. On this basis, therefore, the industry has benefited directly to the extent of more than $10 million in large scale housing projects.

The part plumbing and heating has played in the property improvement credit plan of the FHA is the most difficult to estimate, officials state, doubly so because lending agencies have 30 days in which to report these loans and no individual accounting of contemplated expenditures is required. One indication of the extent to which plumbing and heating is participating may be found in the announcement of a spokesman for a large heating company who declared that one day's mail recently brought 2,700 applications from dealers for modernization loan blanks, constituting "a response without parallel in our experience."

Tacoma Gets Very Low Power Rate

SEATTLE — Development of electric heat for homes, houses, and commercial buildings in this district is expected to be furthered by new low electric power rates in the Puget Sound region. In Tacoma, effective in January, electric power is now available in homes for 4½ cents per kw-hr. for the first 20 kw-hr., 1 cent for the next 400 kw-hr., and ½ cent for all over 420 kw-hr.

Refrigeration Group Holds Show and Convention in Chicago

CHICAGO—The first annual All-Industry Refrigeration and Air Conditioning Exhibition was held at the Stevens Hotel here January 16-19. The show was sponsored by the Refrigeration Supplies and Parts Manufacturers Association.

In connection with the Exhibition the meeting of the Association was held simultaneously and included a reception for Gardner Poole, ASRE president, and an address "We the People of a United Industry" by W. H. Burritt, Nash-Kelvinator Corporation. "A Toast to 1930" by F. M. Cockrell, publisher of Air Conditioning & Refrigeration News, and other events.

One hundred firms exhibited, including Air-Maze Corp., Alco Valve Co., Inc., The American Brass Co., Arco Pipe & Fittings Div. of American Radiator Co., Anemostat Corp. of America, Automatic Products Co., Bonney Forge & Tool Works, Brunner Manufacturing Co., The Bush Manufacturing Co., The Dayton Rubber Co., Detroit Lubricator Co., E. I. DuPont de Nemours & Co., Fairbanks, Morse & Co., Fedders Mfg. Co., Inc., General Electric Co., Henry Valve Co., Howe Ice Machine Co., Larkin Coils, Inc., Jas. P. Marsh Corp., McCord Radiator & Mfg. Co., The Mercoid Corp., Mills Novelty Co., Minneapolis-Honeywell Regulator Co., Mueller Brass Co., Peerless of America, Inc., Penn Electric Switch, Perfex Corp., Refrigeration & Air Conditioning Institute, Wagner Electric Co., White-Rodgers Electric Co., and Wolverine Tube Co.

J. S. Forbes, president of the Superior Valve and Fittings Co., was elected president of the association succeeding J. D. Colyer. H. V. Higby, president of Ansul Chemical Co., formerly treasurer, was elected vice-president, and E. A. Vallee, vice-president of Automatic Products Co., was elected treasurer.

The Exhibition was in charge of a committee consisting of M. W. Knight, chairman, J. L. Shrode, J. F. Gleason, and Messrs. Colyer and McClure. The publicity committee consisted of K. B. Thorndike, chairman, W. C. Allen, Herman Goldberg, and Messrs. Colyer and McClure.

Simultaneous with the convention and exhibition, dealers attending voted the formation of a national council to establish a new organization to represent them. The council was appointed to handle the details incident to the beginning of the new group as follows: Alfred Epstein, Independent Refrigeration Co., Los Angeles; C. E. Hanson, Smith and Oby Co., Cleveland; H. E. Wheeler, Air Comfort Corp., Chicago; Ben Natkin, Natkin and Co., Kansas City; and C. E. Tupper, of Minneapolis.

Soviet Gasifies Coal Underground to Cut Energy Production Cost

MOSCOW—According to Vasili Matveyev, head of the central gas administration, the Soviet Union has started an entirely new industry—the underground gasification of coal. An underground gasification station is operating in Gorlovka, another station in Lisichansk will open soon, and construction of two large stations is to be started early this year. Approximately 1500 men are already employed in this industry.

As far back as the end of the last century, Mendeleyev, the great Russian chemist, wrote that in his opinion great reduction in the cost of coal production was possible only if the energy in the coal could be utilized right in the mines, without mining; he saw no basic difficulties in the problem.

The first attempts to construct experimental apparatus for underground coal gasification were made by the late Sir William Ramsay, famous British scientist. Nothing came of these attempts, however.

An underground coal gasification station is an intricate system of underground and surface structures. Compressors for steam and air or oxygen blasting, electrical distributors, apparatus for cooling and filtering the gases, a boiler house and a network of pipe lines are situated on the surface. Underground there are several ignited coal seams and others in a state of preparation. This make-up of the station has been determined as a result of investigations conducted at experimental installations in the Soviet Union since 1933.

The production cost of power gas obtained by underground gasification is said to be considerably lower than that obtained in generating stations working on coal. A comparison of the figures of one of the largest chemical plants producing gas for its needs with the figures of the Gorlovka experimental station reveals that the gas obtained by undeground gasification is one-fourth the cost of the former. Capital investments in underground gasification stations, moreover, are claimed by the Russians between 30 and 40% below those in ordinary generating stations.

Engines Heat 74-Passenger Plane

SEATTLE—The world's largest airplane, a Pan American Clipper, which will accommodate 74 passengers, has just been turned out of the Boeing plant here. It is equipped with a thermostatically-controlled heating system. The system uses exhaust heat from two of the four engines, each of which is capable of supplying sufficient heat to maintain the comfortable conditions in the plane. The plane is insulated and soundproof.

Producers Council Plans Campaign to Promote New Building

NEW YORK—Representing a new and powerful effort to sell home building to the American public, executives of 19 leading corporations in the building equipment and material field assembled January 11 at the Waldorf-Astoria to formulate a program for 1939 designed to complement government efforts along similar lines. Actually representative of a much larger industrial group—the 66 members of the Producers Council—the meeting was the first for the newly-elected advisory board of the council, which is made up of the chief executives, in most cases, of certain member corporation.

Objectives of the advisory board are to consider ways and means of promoting the common interests of building equipment and materials manufacturers; to establish through an adequate public relations program proper relations between the manufacturing division of the industry and other industries; to sponsor the educational activities of the Producers Council among its members; to attempt to determine the importance of home building in national economy; to consider means of balancing public works expenditures; and in general to develop a sound policy for construction and home building. The January 11 meeting was called to consider an extension and enlargement of the "More Home for Your Money" program which was carried on by the council last year with the object of presenting to the public the story of values existing in modern homes and to combat the widespread "high cost of building" propaganda. The 1938 program was one of the outstanding activities of the building industry, functioning in 34 states with the help of newspapers, architects, builders, realtors and other agencies.

Chairman of the advisory board is Charles E. Wilson, executive vice-president of the General Electric Co. The board includes: Lewis L. Bredin, president, Chamberlin Metal Weather Strip Co.; Lewis H. Brown, president, Johns-Manville Corp.; Rolland J. Hamilton, president, American Radiator Co.; Herbert V. Kohler, president, Kohler Co.; J. A. Lyle, president, Carrier Corp.; Charles B. Nolte, president, Crane Co.; H. W. Prentis, Jr., president, Armstrong Cork Co.; and Frank B. Williams, Jr., vice-president, Westinghouse Electric and Mfg. Co.

Ostby Now N. Y. Coal Coordinator

NEW YORK—Oscar F. Ostby has been appointed by the executive committee of the Retail Solid Fuel Industry in the City of New York to act as Coordinator. Mr. Ostby succeeds Roderick Stephens, who resigned January 12. Mr. Ostby was formerly connected with Anthracite Industries Inc.

Contractors Group 50 Years Old, Plans Celebration in Chicago

NEW YORK—The Heating, Piping and Air Conditioning Contractors National Association will celebrate its 50th anniversary at the Drake Hotel, Chicago, May 31-June 2.

A half century ago on April 12, 1889, a few men conceived the idea of a national association, acted upon the idea and incorporated the association under the laws of Illinois. The original incorporators were John Davis, Polhemus S. Hudson, Foster W. Lamb, Chas. H. Simmons, Herman Kroeschell, Samuel I. Pope, Albert Galloway, Leon H. Prentice, and George H. Reynolds. In the fall of 1889 the members assembled at the Leland Hotel, Chicago. From that time on a convention was held every year except 1917.

The convention elected as officers for the first year: president, Chas. J. Gillis; 1st vice-president, Samuel I. Pope; 2nd vice-president, A. B. Franklin; 3rd vice-president, H. D. Crane; secretary, George H. Reynolds; treasurer, H. A. Kroeschell.

The association is making an intensive effort to find all those still living who attended that first convention. So far the roll call shows among the contractors William A. Beggs of Seattle, who was then in business in Denver, and J. W. Partlan of Detroit. Mr. Beggs was accompanied by his wife, who is still living, and by his infant son, William E. Beggs, who today is actively engaged in the heating business in Seattle. Two men who attended the meeting as manufacturers' representatives have been found—F. A. Herendeen of Geneva, N. Y., and C. M. Woolley of New York. The association would appreciate hearing from any others who were present at that meeting.

Frank A. Merrill of Boston, Mass., who was elected president of the association in 1924 and reelected in 1925, is chairman of the 50th anniversary committee, and has as his associates on that committee the following who have served as presidents of the National Association: Juan A. Almirall, J. Lawrence DeNeille, Harry M. Hart, Walter Klie, William H. Oakes, J. E. Rutzler, Ray L. Spitzley, H. Merwin Porter, Robert D. Williams, John H. Zink, and Henry B. Gombers, secretary-emeritus of the association.

The national convention committee consists of Frank E. Kise, James M. Anderson, Mr. DeNeille, and Wray M. Scott.

Armagnac Joins Trade Paper Staff

NEW YORK—A. S. Armagnac, for many years editor and publisher of HEATING & VENTILATING, has joined the staff of "Sheet Metal Worker" as associate editor, according to an announcement by Edwin A. Scott, publisher.

1938 Was Biggest Year for FHA; Total Business Over a Billion

WASHINGTON—The Federal Housing Administration in 1938, despite the lag in residential construction during the early part of the year, transacted a total business of nearly a billion and a quarter dollars, the largest annual volume in its history, according to Administrator Stewart McDonald.

FHA mortgage insurance activities, which last spring began to reflect the part residential construction would play in the current recovery movement, showed a 71% increase in the value of small home mortgages selected for appraisal, and a 45% increase in the value of mortgages accepted for insurance.

Property improvement loans insured under the 1938 amendments for the 11 months of February through December amounted to $171,719,000 during 1938. This phase of the FHA's activities, a part of the original National Housing Act, lapsed on April 1, 1937, but was restored later.

Price Addresses Buffalo Council

BUFFALO—William H. Price, Jr., vice-president of Carrier Corp., Syracuse, and president of the Air Conditioning Manufacturers' Association, was guest speaker at a meeting of the Air Conditioning Council of Western New York held in the University Club.

Discussing "Crusading for Creativeness in Air Conditioning Sales Work," Mr. Price said: "There's a very profitable future for the industry if we will go out and plow up business and precipitate prospects into the market. There's no future at all, however, if we are going to sit idly by and wait for customers to come in our doors."

The program included presentation of a plaque to Roswell Farnham, outgoing president of the Council, in appreciation of his efforts in behalf of the group. Joseph Davis, the new president, made the presentation.

Washington U. Sponsors Conference

ST. LOUIS—A coal conference will be held at Washington University here May 19-20, according to Richard L. Wood, executive secretary of the local Coal Exchange.

This conference will be held under the sponsorship of the school of engineering headed by Dean Langsdorf, the Smoke Department of the city, headed by Raymond Tucker, and the Coal Exchange.

Inspector Addresses Seattle Group

SEATTLE—Ray Maxwell, chief safety inspector of the Puget Sound Power & Light Company, was the principal speaker at the January meeting of the ASHVE Pacific Northwest chapter. Mr. Maxwell spoke on Safety Practices.

Hydrogen Burns, Carbon is Catalyst; Result, Heat from Sun

BUFFALO—Scientists on December 17 listened to a theory that the enormous heat generated by the sun—estimated to be 20 million F at its center—is produced from carbon.

The reason, according to a new theory advanced by Prof. Hans A. Bethe of Cornell University, is not that so much of the carbon as found in coal—is on the sun, but that what there is of it is "regenerated," or used many times in producing hydrogen, which is ignited.

Thus in the case of the sun, is developed heat that Professor Bethe estimates is equivalent to the burning of 10 million billion tons of coal a second. And thus is posed a new goal for practical scientists to reach: Reproduction on the earth of combustion as found in heavenly bodies, but with means of regulating such combustion so that it will be safe to use on the earth.

In explaining his theory, Professor Bethe pointed out that for more than a century scientists have wondered about the origin of the enormous amount of heat continuously radiated by the sun and stars. The first recorded idea was that every particle in the sun falls toward the sun's center, and that the energy of these falling bodies is converted into heat. But it was later proven that such a source of energy would be far too small. The same objection was raised against the later hypothesis that radioactivity was the source of solar energy.

Professor Bethe's answer is:

A carbon nucleus "captures" a hydrogen nucleus to form a nitrogen nucleus. This nitrogen nucleus again is bombarded by hydrogen nuclei, and finally a helium nucleus is produced and the original carbon nucleus is regenerated.

On earth, carbon burns in oxygen, but in the sun it burns in hydrogen. Actually, according to the professor, it is the hydrogen that is burning; four hydrogen nuclei and two electrons unite in a helium nucleus, and the carbon serves to bring them together.

Duncan Speaks on Pipe Welding

TORONTO, ONT.—The regular meeting of the ASHVE Ontario chapter, held in the Royal York Hotel January 9, was attended by 55 members and guests to hear an address by W. A. Duncan, whose subject was Modern Oxy-Acetylene Welding of Piping. Mr. Duncan also showed a movie on Welding.

W. M. Shears, secretary of the code committee, asked for adoption of the warm air heating code as proposed. It was moved by J. Woolard and seconded by A. Paul that the infiltration factors in this code agree with the infiltration factors in the steam and hot water heating code recently adopted by the society. The motion carried.

Boston A.C. Bureau Starts 6th Year

BOSTON—With the January 12 meeting and dinner, the Air Conditioning Bureau of Boston entered upon the sixth year of its existence, bearing the distinction of being the largest and most active organization of its kind in the industry.

Starting in 1933 with a membership of 28, this has grown to 214, with a high average of attendance at monthly meetings, when some of the most prominent men in the air conditioning and allied industries have been guest speakers.

The guest speaker of the evening was Charles Penrose, senior vice-president for North America of the Newcomen Society of England, and vice-president of Day & Zimmermann, Philadelphia. His subject was "Industry's History."

Cooperating in preparing the program for the meeting were the Engineering Societies of New England, Associated Industries and the New England Council, Julius Daniels, past president of the Bureau, was chairman and toastmaster.

A.C. Alliance Headed by DeBerard

CHICAGO—The Air Conditioning Contractors' Alliance held its annual meeting at its offices, 7 South Dearborn Street, January 16. The following officers were elected: president: Philip E. DeBerard, Conditioned Air Systems, Inc.; vice-president: William L. Wente, W. L. Wente Co.; secretary and treasurer: R. Hamlin Petty, Sr.

Directors were elected as follows: Fred L. Lensing, A. W. Lensing Sons, Inc.; W. D. Dresen, of Dresen Engineering Co.; E. Valkenaar; John H. Knoll, Midwest Ventilating Co., and W. B. Borgraeve, Alladen Engrg. Co.

Philadelphia Has A.C. Apartment

PHILADELPHIA—What is said to be the first completely air conditioned apartment house here has been opened at 427 W. Chelten Ave., Germantown. Each apartment is furnished with humidified air in winter and dehumidified and cooled air in the summer through ducts built into the walls and partitions, which are also soundproofed to insure privacy between the apartments.

Detroiters Inspect Utility Building

DETROIT — The ASHVE Michigan chapter was the guest of the Detroit Edison Company at the regular monthly meeting January 16. The meeting was held in the general offices of the utility with 125 present. Following the dinner the guests inspected the new air conditioned Service Building of the company. After the trip J. H. Walker discussed some of the interesting features of the new building.

U. S. Steel Completes New Plant; Has 80-in. Continuous Strip Mill

PITTSBURGH—One of the largest industrial plants ever built as a single unit was completed in December by the Carnegie-Illinois Steel Corp., a subsidiary of the United States Steel Corp. The plant includes an 80-in. continuous hot strip mill capable of rolling 600,000 tons of sheet and strip per year. The plant, which represents an investment of $60 million, is named the Irvin Works in honor of William A. Irvin, vice-chairman of the board of directors of U. S. Steel.

In addition to the 80-in. hot strip mill, there are an 84-in. cold reduction mill; a 54-in. cold reduction mill; a 42-in. cold reduction mill for tin plate, and required finishing departments.

The main mill electrical equipment is all located in a special motor room 65 x 700 ft. This room is ventilated by filtered air under a slight pressure to exclude dust. The ventilating system is designed to handle 525,000 c.f.m. at 95F. Approximately 4100 gal. of 85F water are used per minute to cool the air discharged from the machines from 125F to 95F.

New York Adds 901 A.C. Jobs in '38

NEW YORK—During the whole of 1938, 690 air conditioning installations were added to the lines of the Consolidated Edison Company of New York, Inc., in Manhattan and the Bronx. These totaled 12,975 hp. Of the total, 501 were less than 10 hp., 65 were from 10 to 20 hp., and 124 were over 20 hp. One hundred installations totaling 1537 hp. were added to the lines of the Brooklyn Edison Company during the year, while 111 installations, totaling 5775 hp., were added to the lines of the New York and Queens Electric Light & Power Company.

Miller Elected by N.Y. Contractors

NEW YORK—The Association of Plumbing & Heating Contractors of Greater New York, Inc., with headquarters at 304 East 62 Street, has elected new officers for 1939. They were inducted into office January 11. The new officers are: President, Jack Miller; vice-president, Otto Haag; treasurer, Walter Fimian; and chairman of the board of directors, Philip Wolf.

New Airport to Have Central Heat

SEATTLE—A $15 million airport is being constructed by the War Department near Fort Lewis, Wash., and will be named the McChord Field. A central heating plant will supply the airport buildings, including the hangar and soldiers' barracks. The Walter S. Leland Co., San Francisco, submitted the low bid for the central heating plant amounting to $539,600.

Fire Hazards Subject of Meeting

PITTSBURGH—The January meeting of the Pittsburgh ASHVE chapter had as the speaker of the evening W. Kaye Estep, manager of the Middle Department Rating Association whose subject was Fire Underwriters Views On Heating And Air Conditioning Systems. Factors concerning fire insurance rates are determined by the amount of common or special fire hazards. While much work has been done by the Underwriters Laboratories and other organizations much depends upon the proper installation of the approved equipment. It was pointed out that there were 263 fires from air conditioning systems last year, which shows the importance of taking proper precautions when designing and installing ductwork. Since ducts tend to become filled with dust, lint, and foreign matter it is important to provide inspection openings in the ducts for cleaning. Automatic dampers should be located at the fresh air intake.

The speaker regards combustible filters as a hazard. Good building construction is sometimes nullified by the installation of air conditioning systems that have raised the rate for fire insurance. To bring the insurance rates within reason it is sometimes necessary to tear out and rebuild much of the air conditioning equipment. This the contractor should try to avoid.

Air conditioning systems have been a factor in reducing fire hazards in places where static electricity had to be eliminated, such as in the cereal industry and hospital operating rooms.

Output of Industry in '37 Measured

WASHINGTON — Information concerning the number and value of heating equipments made during 1937 has been compiled by the Department of Commerce in the 1937 Census of Manufactures. The following tabulation summarizes the available information:

EQUIPMENT	NUMBER	VALUE
Cast-iron boilers	85,844	$ 8,163,311
Cast-iron boilers, number not reported	—	7,712,366
Steel heating boilers	20,789	6,897,317
Steel heating boilers, number not reported	—	866,875
Parts for heating boilers	—	1,311,174
Cast-iron radiators	—	14,749,497
Copper radiators	—	2,269,969
Gas and oil-fired radiators	—	67,316
Warm air furnaces	344,998	26,426,693
Warm air furnaces, number not reported	—	2,091,162
Furnace parts and registers	—	9,679,285
Unit heaters	56,847	5,863,376
Unit heaters, number not reported	—	1,331,139
Domestic oil burners, mechanical	170,458	15,892,163
Domestic oil burners, natural draft	3,575	136,539
Boiler burner units	9,398	2,326,287
Furnace burner units	11,916	2,600,041
Gas conversion burners, domestic	26,074	1,565,703
Gas conversion burners, domestic, number not reported	—	382,222
Gas burner units, complete with boilers of furnaces	—	3,105,586
Valves and fittings	—	66,921,369
Thermostats (including industrial and cooking)	11,789,942	22,697,599
Regulators	—	4,800,619
Traps	—	4,213,771

Year-Round A.C. to be Featured at Illinois Conference

URBANA—The program for the 1939 Conference on Air Conditioning, to be held at the University of Illinois March 8-9, has been announced. The scope of the conference will be year-round comfort air conditioning. The conference is being promoted for the benefit of dealers, installers, owners, and prospective owners of comfort air conditioning. The program includes:

MARCH 8

a.m.

Equipment for All-Year Air Conditioning, W. H. Severns, professor of mechanical engineering, and P. E. Mohn, assistant professor of mechanical eng.neering, University of Illinois.

Characteristics of Duct Systems and Fans, S. H. Downs, chief engineer, Clarage Fan Co.

p.m.

Introduction and Diffusion of Conditioned Air in Rooms, D. W. Nelson, assistant professor of steam and gas engineering, University of Wisconsin.

Regulation of Air Temperature and Humidity, C. L. Ringquist, The Trane Co.

evening

Dinner-Address Physiological Responses of the Body to Its Environment, Dr. Charles Sheard, director, division of physics and biophysical research, The Mayo Foundation.

MARCH 9

a.m.

The Cooling Load and Refrigerating Problems in Comfort Air Conditioning, R. E. Gould, assistant manager, air conditioning engineering, Frigidaire Div., General Motors.

Building Insulation, Types and Applications, Prof. S. Konzo, University of Illinois.

Condensation Problems in Modern Buildings, L. V. Teesdale, senior engineer, U. S. Dept. of Agriculture Forest Service, Forest Products Laboratory.

p.m.

Air Conditioning Water Supply and Disposal, W. D. Gerber, engineer, Illinois State Water Survey, Urbana.

Conservation of Water by Using Cooling Towers and Evaporative Condensers, S. I. Rottmayer, mechanical engineer, office of S. R. Lewis, Chicago.

Sessions are scheduled on Central standard time and the University announces that there will be no registration or tuition fee. Requests for reservations or additional information can be obtained from Prof. W. H. Severns, 103 Mechanical Engineering Laboratory, Urbana, Ill.

Boston A.C. Growing, Bureau Finds

BOSTON—In 1932, according to figures compiled by the Air Conditioning Bureau, there was a total of 4168 connected horsepower load of air conditioning in metropolitan Boston. Most of this was either industrial or theatre air conditioning. By 1935, 500 more horsepower had been added, and in the next four years the connected horsepower load increased at the rate of between 2,000 and 3,000 hp. per year, until at the end of 1937 the total was 15,000 hp. The number of installations increased about 30% in 1938 but the horsepower remained practically the same. This is indicative of the widened scope in smaller business establishments.

Thirty-five per cent of the cost of an average installation goes for compressors; about 20% for duct work, 20% more for heat transfer units, and 10% for electrical equipment, such as motors and wiring. The balance goes for labor.

Russell B. Tewksbury

SARASOTA, FLA.—Russell B. Tewksbury, chairman of the board of The Oster Manufacturing Co., Cleveland, died January 1 at his winter home here. He was 79.

One of the founders of The Oster Manufacturing Company in 1893, Mr. Tewksbury became president of the company in 1898, holding that position until five years ago when his son, Roger G., succeeded him and he became chairman of the board.

Mr. Tewksbury was also a director of the Cleveland Tractor Company and the Electric Railway Improvement Company of Cleveland. He is survived by his widow, two sons, a daughter, and eight grandchildren.

William Robbins Seigle

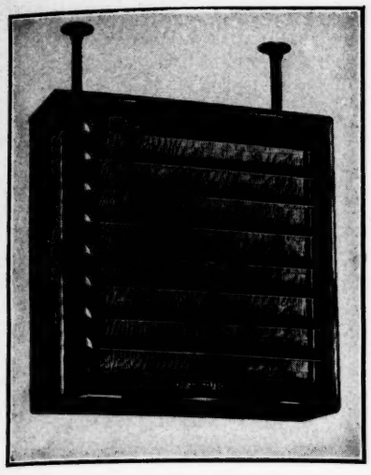
ROCHESTER, MINN.—William Robbins Seigle, chairman of the board of directors, vice-president and director of research of Johns-Manville Corporation, died here December 26 at St. Mary's Hospital, after having undergone an operation at the Mayo clinic on December 6. He was 59.

Mr. Seigle had been connected with Johns-Manville for nearly forty years. He is survived by his widow, four daughters, two sons, and two brothers.

A. A. Adler

NEW YORK—Alphonse A. Adler, consulting engineer of Arlington, N. J., died of a heart attack January 13 in a tube train at Jersey City. Mr. Adler had long been known in heating circles in New York and in more recent years had also been prominently identified with educational work in local universities.

NEW EQUIPMENT



Kramer Unit Heaters

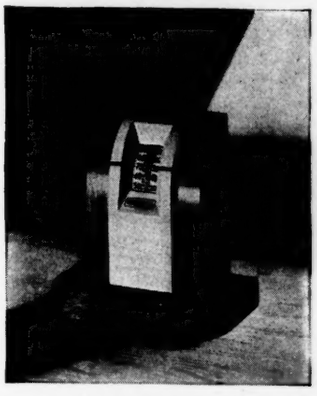
NAME—Kramer unit heaters.
PURPOSE—A unit type heater for air heating utilizing hot water or steam.
FEATURES—The heater or condensing coil consists of a series of horizontally placed, hair-pin tube bends, oval in cross section, with one end of one leg brazed into a cylindrical steam supply manifold and the other end into a return manifold. This bend is provided to take care of thermal expansion and contraction. The entire heating element is constructed of copper. A die formed, streamline steel frame encloses the heating element. This frame is finished in twilight-gray crackle enamel baked on. Integral with the back of the frame is a die formed air inlet housing the fan. The unit heater may be used with any steam pressures up to 150 lb. per sq. in.
SIZES AND CAPACITIES—Made in 16 sizes with capacities ranging from 18,700 to 237,000 B.t.u. per hr. with 70F entering air and 2 lb. steam.
LITERATURE—Bulletin H 139.
MADE BY—*Trenton Auto Radiator Works, Trenton, N. J.* *1*

Thrush Water Heaters

NAME—Thrush water heaters.
PURPOSE—For heating domestic hot water using boiler water.
FEATURES—These heaters are constructed of straight copper tubes within a solid cast-iron housing, which provides diagonal boiler water flow. Both ends can be removed for cleaning the heater. Heater may be used with either hot water or steam boilers.
MADE BY—*H. A. Thrush & Co., Peru, Ind.* *2*

Carson Airgraph

NAME—Carson Airgraph.
PURPOSE—A device for indicating the temperature and relative humidity of room air.
FEATURES—This instrument consists of a thermometer and a hygrometer working on revolving drums, which is said to make it possible to read the temperature and the relative humidity of the room directly without the calculations or the use of charts. The instruments are mounted in a hand rubbed, solid walnut and maple case. Price, $3.50.
MADE BY—*Carson Manufacturing Co., Chicago, Ill.* *3*

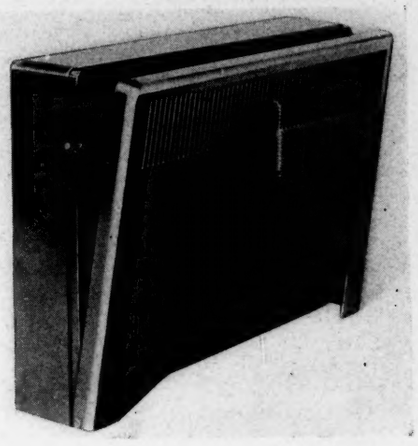


Sarco Temperature Control Valve

NAME AND MODEL NUMBER—Self-contained electric temperature regulator, type SE.
PURPOSE—For regulating the supply of heating medium to maintain any temperature between 40 and 650F.
FEATURES—Valve is of the throttling type and is said to adjust itself automatically to any position between wide open and closed. The sensitivity of the regulator is adjustable in use. Each regulator may be calibrated at the factory for any desired temperature between —40 and 650F and is then adjustable in the field for 50F higher or lower than factory calibration. Standard valves from ½ to 2 in. have a bronze body, stainless steel trimmed, and union connections. Valves 2½ to 4 in. are iron body, bronze trimmed; sizes 2½ to 3½ in. are screwed; 4 in., flanged. Regulators may be connected directly across the line to operate on single phase a.c. current, 110 or 220 volts.
SIZES—From ½ to 4 in. pipe size.
MADE BY—*Sarco Company, Inc., New York, N. Y.* *4*

Modine Convector Enclosures

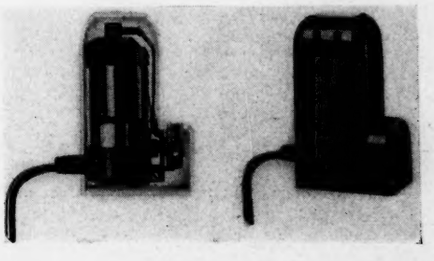
NAME—Modine standard and institutional enclosures.



PURPOSE—For enclosing the Modine standard and institutional copper convectors.
FEATURES—These enclosures have a front which can be removed without tools by simply disengaging two catches with the hands. Both kinds of convectors are available in types which may be recessed into the wall, hung on the surface of the wall or stood on the floor, flush against the wall. The institutional line has been designed to meet the requirements peculiar to institutional heating. This line includes as standard equipment such items as a lock-type removable front, lock-type dampers, heavier gages of metals and square lattice grilles. The standard convector is intended for use in department stores, offices, hotels, as well as single-family dwellings.
MADE BY—*Modine Manufacturing Co., Racine, Wis.* *5*

Sullivan Air Valve

NAME—Sullivan R.T.C. air valve.
PURPOSE—A thermostatic air valve for giving individual room temperature control on one-pipe steam heating systems.
FEATURES—Valve is designed to replace the ordinary air valve and it is said that it can be installed in a few minutes. The manufacturer states that by setting the dial any temperature between 60 and 80F can be maintained.
MADE BY—*Sullivan Valve & Engineering Co., Butte, Mont.* *6*

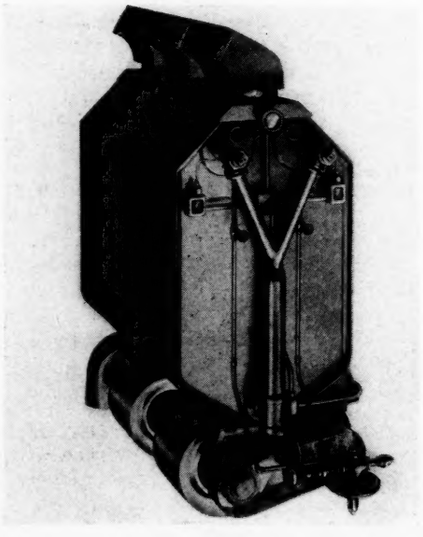


Simplex Air Filter Watchman

NAME—Electric Filter Watchman.
PURPOSE—To indicate when air filters are clogged to the extent that they should be cleaned or replaced.
FEATURES—Device is primarily a bellows-operated electric switch which is mounted on the outside of the conditioner at any point between the filters and blowers. By a simple adjustment the Watchman may be set for any desired pressure drop through the filters. Any excess pressure depresses the bellows of the instrument, making an electric contact to light a red signal. The signal continues to burn until the filters are removed or cleaned.
MADE BY—*Simplex Controls, St. Louis, Mo.* 7

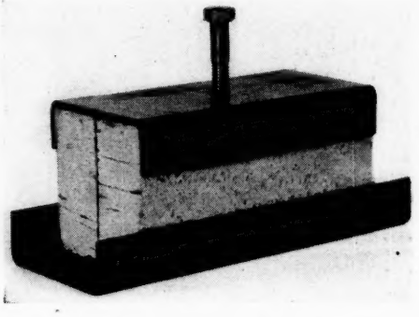
Lee Unit Heater

NAME—Lee suspended type unit heater.
PURPOSE—A high capacity suspended type gas-fired unit heater for use in large industrial buildings where high velocity heated air is desired to heat rooms of large floor area or high ceilings.
FEATURES—Unit will operate on natural gas, manufactured gas, or coke oven gas and is 3 ft. wide, 5 ft. long and 7 ft. high. It weighs about 3000 lb. and is of welded steel construction. The air discharge is 5500 c.f.m. with an average temperature rise of 110F. Air velocity at heater outlets is 2000 f.p.m.
CAPACITIES—500,000 B.t.u. per hr. output.
MADE BY—*Dravo Corp., Machinery Div.. Pittsburgh, Pa.* 8



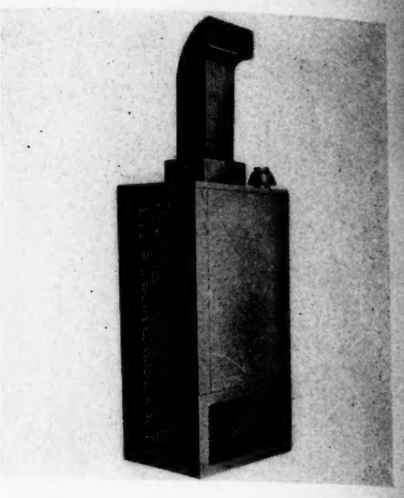
Korfund Anti-Vibration Bar

NAME—Korfund Vibro-Bar.
PURPOSE—For preventing the transmission of vibrations from light motors, fans, power tools, and other light machinery.
FEATURES—Device is made of close-grained cork, encased by pressed steel channels and bonded in place with a special mastic. The top bolt fastens to the machine leg or base and the lower channel is drilled at both ends to receive the floor bolts. The manufacturer states that the cork is both oil and water resistant and that it will retain its elastic properties indefinitely. It is said that the cross-section modulus is ample to prevent bending and twisting in service. The loading range of this damper is 360 lb. per damper.
MADE BY—*The Korfund Co., Inc.. Long Island City, N. Y.*.....9



American Gas Floor Type Unit Heater

NAME AND MODEL NUMBER—AGP floor type unit heater, Type 1-FP-U.
PURPOSE—A gas-fired floor type unit heater.
FEATURES—Heater has the same type of cored cast iron heating section as is utilized in the AGP gas-fired air conditioners of the parallel-flow and counter-flow types. Air is drawn into the intake grille at the side of the casing at the floor level, is heated as the fan in the base blows it over the heat exchanger and is discharged through a diffusing cowl above the head level. Fan is a double inlet, Sirocco a.c. type with die formed. streamlined inlets. The cowl is square, permitting discharge connection on either side, front, or back.
SIZES AND CAPACITIES—Four sizes with hourly inputs from 56,000 to 150,000 B.t.u. per hr.
MADE BY—*American Gas Products Div., American Radiator Co., 40 W. 40th St., New York*.....10



Thrush One-Pipe Fittings

NAME—Thrush one-pipe fittings.
PURPOSE—A one-pipe fitting or supply tee designed particularly for one-pipe hot water heating systems.
FEATURES—The manufacturer states that these fittings are convenient to install and offer the advantage of minimum cost on highly competitive work. The fittings have an interior baffle which is designed to insure positive diversion of part of the water from a single-pipe main to provide the proper supply to the radiator. Fittings are made in either bronze or iron.
SIZES—Main sizes from ¾ to 1½ in. with ½-in. outlets.
MADE BY—*H. A. Thrush & Co., Peru, Ind.* 11

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below circle the item number of the equipment in which you are interested, using the number found at the end of each item.

1 2 3 4 5 6 7 8 9 10 11

(This service available only to engineers or executives)

Fill in your name and address, detach and mail to
HEATING & VENTILATING, 148 Lafayette St., New York, N. Y.

Name.....
Title.....
Firm.....
Business Address .....
City and State 2/39

Marching along together

STEEL.. STYLE.... COMFORT

Except for *steel*, the shoes we wear would be little better than medieval sandals, with their shapeless ugliness and destruction of foot health.

The arch which assures comfort, safety, lasting appearance, is made by a steel brace concealed in the leather. Heels are possible because of steel nails. Steel eyelets keep the laces from tearing the leather. The laces thread easily because of steel tips--to say nothing of the steel machinery vital to processing the leather and making the shoes themselves.

It takes almost 100 pieces of steel to make most pairs of modern shoes, and they are only a small fraction of the thousands and thousands of pieces of steel you use every day to make life comfortable and safe. Steel makes possible your electric light, home heating plant, canned food delicacies, automobile, office building and factory, railroad--in fact steel makes possible the standard of living on which civilization depends.

For almost every one of this multitude of uses a special steel is required, and Youngstown maintains a great laboratory and special staffs of research and field experts to find exactly the right steel for every modern use.

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Sheets - Plates - Pipe and Tubular Products - Conduit - Tin Plate - Bars Rods - Wire - Nails - Unions - Tie Plates and Spikes

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

General Offices

Degree-Day Figures for December, 1938

HEATING & VENTILATING continues its eleventh year of publishing degree-day data for various large cities

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for December, 1938.....	1135	650	791	588	959	1045	1209
Degree-days, Sept. 1 to Dec. 31, 1938...	2486	1077	1465	984	1932	2243	2785
Degree-days, Sept. 1 to Dec. 31, 1937..	2423	1408	1704	1245	2192	2626	2930
Degree-days, Sept. 1 to Dec. 31, Normal	2439	1131	1664	913	2130	2372	2773

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for December, 1938.....	1166	1112	885	974	931	965	1127
Degree-days, Sept. 1 to Dec. 31, 1938...	2798	2084	1705	1914	1841	2146	2168
Degree-days, Sept. 1 to Dec. 31, 1937..	2785	2576	2208	2397	2321	2114	2663
Degree-days, Sept. 1 to Dec. 31, Normal	2889	2225	1784	2185	2020	2276	2370

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for December, 1938.....	1077	877	1527	513	1003	845	1062
Degree-days, Sept. 1 to Dec. 31, 1938...	2213	1752	3377	1001	2017	1485	2094
Degree-days, Sept. 1 to Dec. 31, 1937..	2691	2036	3735	886	2490	1914	2649
Degree-days, Sept. 1 to Dec. 31, Normal	2332	1952	3434	1038	2164	1545	2211

	Fort Worth, Tex.	Grand Rapids, Mich.	Green Bay, Wis.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Ithaca, N. Y.
Degree-days for December, 1938.....	502	1074	1294	958	1013	954	1070
Degree-days, Sept. 1 to Dec. 31, 1938...	888	2149	2618	1915	2038	1819	2387
Degree-days, Sept. 1 to Dec. 31, 1937..	1058	2676	3117	2139	2293	2379	2615
Degree-days, Sept. 1 to Dec. 31, Normal	826	2397	2882	1981	2157	2002	2450

	Kansas City, Mo.	Knoxville, Tenn.	La Crosse, Wis.	Lansing, Mich.	Lincoln, Neb.	Little Rock, Ark.	Los Angeles, Calif.
Degree-days for December, 1938.....	898	781	1287	1142	999	632	138
Degree-days, Sept. 1 to Dec. 31, 1938...	1673	1372	2580	2405	1961	1123	262
Degree-days, Sept. 1 to Dec. 31, 1937..	2130	1688	3032	2900	2362	1374	240
Degree-days, Sept. 1 to Dec. 31, Normal	1809	1483	2778	2665	2201	1079	424

	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.	Nashville, Tenn.	New Haven, Conn.
Degree-days for December, 1938.....	839	1262	655	1168	1384	727	954
Degree-days, Sept. 1 to Dec. 31, 1938...	1546	2513	1122	2303	2831	1315	1896
Degree-days, Sept. 1 to Dec. 31, 1937..	1991	3023	1396	2768	3191	1652	2140
Degree-days, Sept. 1 to Dec. 31, Normal	1587	2758	1127	2601	2941	1363	2109

	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.	Peoria, Ill.	Philadelphia, Pa.
Degree-days for December, 1938.....	299	863	617	710	1063	1088	851
Degree-days, Sept. 1 to Dec. 31, 1938...	492	1659	1085	1305	2079	2040	1586
Degree-days, Sept. 1 to Dec. 31, 1937..	617	1916	1353	1615	2504	2580	1856
Degree-days, Sept. 1 to Dec. 31, Normal	403	1849	1195	1379	2284	2323	1735

	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.	Reno, Nev.	Richmond, Va.
Degree-days for December, 1938.....	916	1057	659	954	917	870	747
Degree-days, Sept. 1 to Dec. 31, 1938...	1827	2315	1525	1908	1811	2185	1385
Degree-days, Sept. 1 to Dec. 31, 1937..	2241	2577	1385	2209	2010	1880	1651
Degree-days, Sept. 1 to Dec. 31, Normal	1949	2496	1724	2130	2014	2284	1407

	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.	Spokane, Wash.
Degree-days for December, 1938.....	1032	884	914	356	1023	649	998
Degree-days, Sept. 1 to Dec. 31, 1938...	2225	1551	2152	848	2178	1613	2382
Degree-days, Sept. 1 to Dec. 31, 1937..	2594	2050	1732	748	2422	1502	2220
Degree-days, Sept. 1 to Dec. 31, Normal	2414	1738	2149	949	2274	1881	2583

	Springfield, Ill.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for December, 1938.....	1004	1042	1056	907	1152	825	837
Degree-days, Sept. 1 to Dec. 31, 1938...	1804	2254	2095	1785	2531	1557	1598
Degree-days, Sept. 1 to Dec. 31, 1937..	2336	2485	2576	2026	2681	1807	1945
Degree-days, Sept. 1 to Dec. 31, Normal	2002	2491	2189	1760	2537	1741	1783

Methods of applying the degree-day in connection with the operation of heating plants or for the prediction of fuel consumption of heating plants are described fully in the new enlarged edition of the DEGREE-DAY HANDBOOK, published by HEATING & VENTILATING, 148 Lafayette Street, New York, price $3. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

"GOOD *VALVE* PRACTICE"

For a School Building

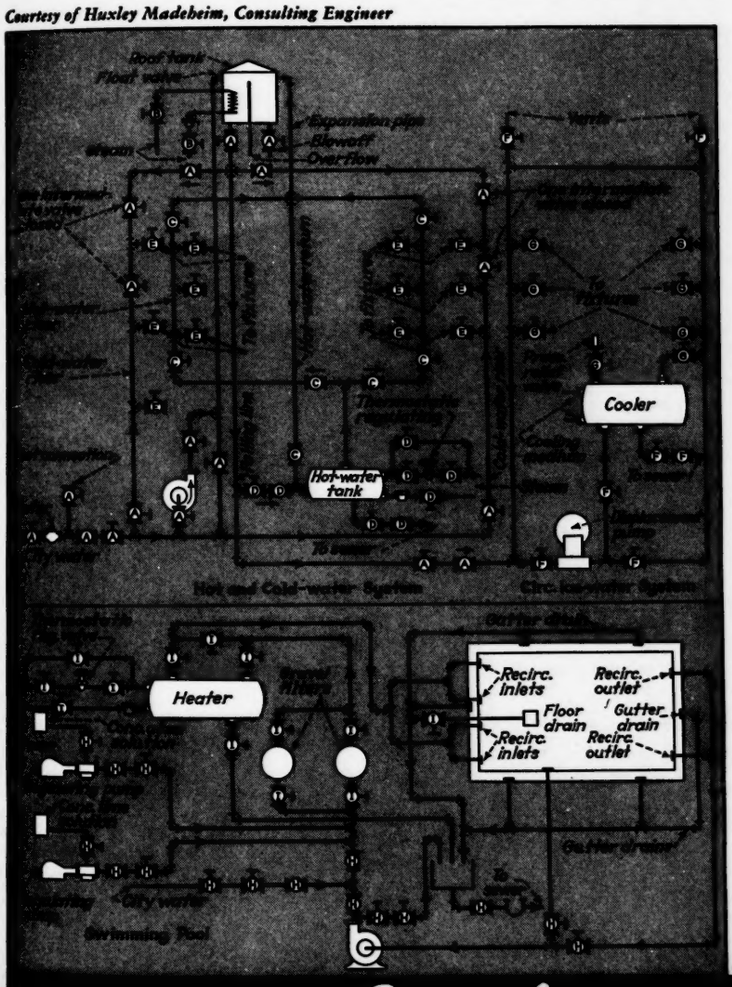
PLUMBING SYSTEM

Jenkins SUGGESTS . . .

AGAIN we utilize a hookup diagram to bring you practical data on the use of Jenkins Valves. The School plumbing layouts below are not intended as rigid recommendations but as typical examples to illustrate accepted good valve usage. Valves are covered only in regard to their proper location and to the correct type for each service. When more than one type may be used, the choice is left to you.

JENKINS BROS., 80 White St., New York, N.Y.; Bridgeport, Conn.; Boston; Chicago; Philadelphia; Atlanta; Houston; Montreal, Canada; London, England

Courtesy of Huxley Madeheim, Consulting Engineer



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

		BRONZE	IRON
A	CITY WATER SUPPLY, COLD WATER RISER AND PUMP GATE	47 Sc. Trav. Spind. 370 Sc. Non-Rising	325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S.&Y. 651 Fl. O.S.&Y.
	SWING CHECK	352 Sc. Disc Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type
B	STEAM SUPPLY GLOBE	106A Sc. Disc Type	
C	HOT WATER RISER AND RETURN GATE	47 Sc. Trav. Spind. 370 Sc. Non-Rising	325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S.&Y. 651 Fl. O.S.&Y.
	SWING CHECK	352 Sc. Disc Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type
D	HOT WATER TANK DRAINS GATE	47 Sc. Trav. Spind. 370 Sc. Non-Rising	325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S.&Y. 651 Fl. O.S.&Y.
	SWING CHECK	352 Sc. Disc Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type
	GLOBE	106A Sc. Disc Type	612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type
	Y OR BLOW-OFF	124 Sc. Disc Type	296 Sc. Disc Type 297 Fl. Disc Type
E	FIXTURE SUPPLY GATE	47 Sc. Trav. Spind. 370 Sc. Non-Rising	
	GLOBE	106A Sc. Disc Type	
	ANGLE	108A Sc. Disc Type	
F	CIRCULATING ICE WATER SYSTEM GATE	47 Sc. Trav. Spind. 370 Sc. Non-Rising	325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S.&Y. 651 Fl. O.S.&Y.
	SWING CHECK	352 Sc. Disc Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type
G	FIXTURE SUPPLY GATE	47 Sc. Trav. Spind. 370 Sc. Non-Rising	
	GLOBE	106A Sc. Disc Type	
	ANGLE	108A Sc. Disc Type	
H	SWIMMING POOL WATER SUPPLY, PUMPS & CONC. LIME SOLUTION GATE	47 Sc. Trav. Spind. 370 Sc. Non-Rising 674 Sc. Non-Rising 675 Fl. Non-Rising 676 Sc. O.S.&Y. 677 Fl. O.S.&Y.	325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S.&Y. 651 Fl. O.S.&Y.
	SWING CHECK	352 Sc. Disc Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type
	GLOBE	106A Sc. Disc Type	612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type
I	STEAM SUPPLY, HEATER, FILTERS & FLOOR DRAIN GLOBE	106A Sc. Disc Type	612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type
	ANGLE	108A Sc. Disc Type	614 Sc. Regrinding 615 Fl. Regrinding 143 Sc. Disc Type 144 Fl. Disc Type
	GATE	47 Sc. Trav. Spind. 370 Sc. Non-Rising 674 Sc. Non-Rising 675 Fl. Non-Rising 676 Sc. O.S.&Y. 677 Fl. O.S.&Y.	325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S.&Y. 651 Fl. O.S.&Y.
	Y OR BLOW-OFF	124 Sc. Disc Type	296 Sc. Disc Type 297 Fl. Disc Type

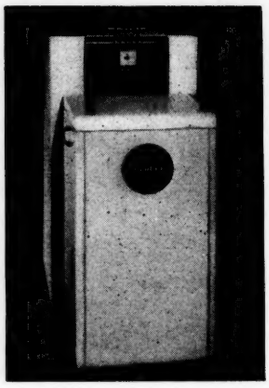
1864 JENKINS TRADE MARK 1939

Jenkins Bros.

DIAMOND ANNIVERSARY

IN VALVES *Jenkins* GIVES YOU EVERYTHING

Hank



Sez—

The New BURNHAM Has Got Religion And Tells How It Got It

Ask most anyone about how much fun they has, setting up jacketed boilers, and you get a Noah's flood of high powered bible words, what weren't originally intended for emphasis.

Near as I can find out from talking to you fellers, it seems to be the opinion, that boiler jackets has caused more lost religions than any other single thing.

As we Burnhams are kinder religious minded folks, all the cussing what's been going on, got us bothered. So we stayed home from church fur a spell and thought up a jacket fur our new Yello-Jacket boiler, what comes durn close to being totally cussless.

As a test, we tried it out on the swearingest cussedest feller in forty counties. He put the jacket on without saying even "gosh."

It ain't stretching the truth none ter say, it goes on 'bout as easy as slipping inter your coat, when the sleeve lining ain't ripped.

So this new Yello-Jacket Burnham, not only stings the fuel bill, but it gives the "red light" ter cussing. 'Course you can cuss if you want ter, but there ain't no call fur it.

Hank Hindle

BURNHAM BOILER CORPORATION

Distributed Through Wholesalers

IRVINGTON, N. Y. ZANESVILLE, OHIO

Branch Offices in All Principal Cities

Export Department: 50 Church St., N. Y. City

Burnham Boiler

WITH THE MANUFACTURERS

Burnham Boiler Corp., Irvington, N. Y., has appointed *Alan Miller* manager of its Philadelphia branch, and *Arthur Kratt* representative in the Newark and Essex County territory, New Jersey.

Carrier Corp., Syracuse, N. Y., has revised its management setup, following the resignation of L. R. Boulware, vice-president and general manager since 1936. Mr. Boulware continues as a member of the board of directors. His former position, however, will not be filled. *Carl A. Ostling* was appointed vice-president in charge of production; *Edward T. Murphy,* formerly vice-president in charge of the Central District, becomes vice-president in charge of marketing; *James A. Bentley,* formerly vice-president and head of the international division, becomes vice-president in charge of finance. The export and marine departments will continue to report to Mr. Bentley. The three vice-presidents will report directly to the president, *J. I. Lyle.*

Everite Pump & Mfg. Co., Lancaster, Pa., has appointed *Curtis R. Story* sales manager. Mr. Story was formerly associated with Fairbanks, Morse.

General Refractories Co., Philadelphia, Pa., has appointed *James P. Raugh* general sales manager. *Fred M. Miller* was named general works manager, and *A. C. Shape* was appointed to succeed Mr. Miller as acting chief engineer.

Illinois Iron & Bolt Co., Free-Man Stoker Div., Carpentersville, Ill., held a meeting of its distributors and their stoker representatives at the Morrison Hotel, Chicago, January 11-12. Speakers for the company included H. C. McNeil, president; J. M. McClintock, manager of the division; G. B. Riddle, sales promotion manager; F. W. Cochrane, eastern division sales manager; J. G. Beard, central division sales manager; Frank Glenn, southern division sales manager; John Slosson, western division sales manager; F. A. Delano, Chicago city sales manager, and others.

Independent Air Filter Co., Chicago, has decided to discontinue its business. Affairs of the company are now in liquidation and the process will be completed as rapidly as possible. Adequate arrangements have been made to complete all outstanding orders and continue indefinitely all required service to customers having Independent equipment.

International Heater Co., Utica, N. Y., at its annual meeting of stockholders and directors January 26 elected the following officers: president, *Irving L. Jones;* vice-president, *L. R. Taylor;* vice-president and secretary, *H. F. Randolph;* treasurer, *R. L. Griffiths;* assistant secretary and assistant treasurer, *H. A. Chester.*

Owens-Corning Fiberglas Corp., Toledo, Ohio, is opening branch sales offices in Boston, New York, Pittsburgh, Cincinnati, Detroit, and Chicago, according to *George E. Gregory,* general sales manager. *C. H. Soderberg,* who will represent the company in the Boston office, was for 11 years consulting engineer on mechanical equipment of buildings and power plant design before joining Owens-Illinois seven years ago. *W. B. Dias* will be New York sales representative for all commodities of the company. Mr. Dias, following graduation from Carnegie Tech and Lake Erie School of Law, was admitted to the Ohio bar before joining Westinghouse; following this he joined the Herman

Nelson Corporation. He came to Owens-Illinois eight years ago. *Charles L. Day* will be special engineer in the New York office. Mr. Day was with Johns-Manville for 14 years. *James L. Elwood,* Pittsburgh sales representative, held various executive and technical positions with Remy, United Motors Service, Chevrolet, and Owens-Illinois. *John B. Schneller,* Detroit representative, was with Briggs Manufacturing Company before joining Owens-Illinois Glass Company. *D. S. Smith,* Cincinnati sales representative, was with Liberty Mutual Insurance Company in Boston, before joining Corning Glass Works. *G. F. Becker,* Chicago sales representative, was for 25 years with Johns-Manville and later became associated with Owens-Illinois Glass Company. *Frank L. Myers,* Chicago sales representative, has been with Owens-Illinois for seven years.

Petroleum Heat and Power Co., Stamford, Conn., has appointed *B. Dunkley* general sales manager. Mr. Dunkley was formerly with The Deming Co., Salem, Ohio, as eastern division manager.

Revere Copper and Brass, Inc., New York, has appointed *Louis J. Galbreath* technical advisor for the New York district sales division, with headquarters at 75 E. 45th St., New York. Mr. Galbreath formerly headed Revere's product development department.

Revere Copper and Brass Inc., 230 Park Ave., New York, has completed a $3,250,000 brass and copper mill at Rome as part of a huge modernization program.

The Trane Co., La Crosse, Wis., has named *English and Lauer, Inc.,* 1978 S. Los Angeles St., Los Angeles, Calif., exclusive representative in southern California.

NEW TRADE LITERATURE

Flexible Metal Tubing. A 20-page booklet entitled "The Fact Book of Flexible Metal Hose and Tubing." Booklet illustrates and lists the principal types and forms of flexible metal hose and tube for the information of design engineers and users. Explains the underlying engineering principles which have made possible the development of flexible hose and tubing. FLEXIBLE METAL HOSE & TUBING INSTITUTE, NEW YORK. 12

Pipe. A 32-page catalog, No. 38A, on repair clamps and saddles for steel and cast iron pipe. Illustrates and describes a number of types of repair clamps and saddles for stopping leaks in steam, hot or cold water, gas, oil, ammonia or brine lines. M. B. SKINNER CO., SOUTH BEND, IND. 13

TO OBTAIN COPIES OF TRADE LITERATURE listed in this issue, circle on the list below the publications wanted, using the item number at the end of each review; fill in your name and address, mail to

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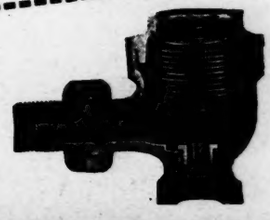

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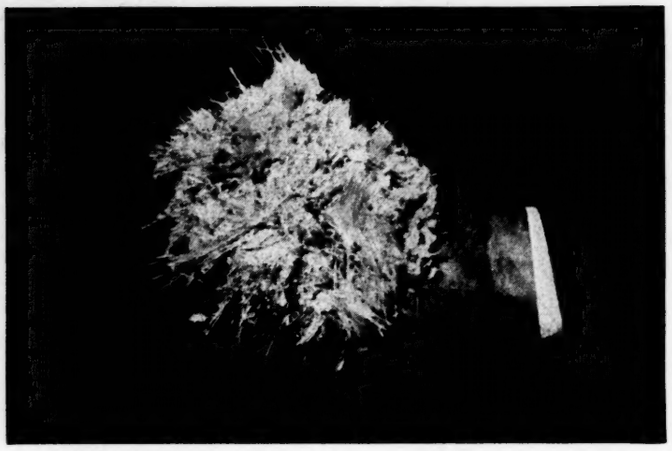

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Humidity Recorder. A standard-size, eight-page catalog, No. N-92, illustrating and describing the Micromax direct-reading humidity recorder. This instrument is designed to indicate and record simultaneously the relative humidity of air. Catalog describes the operation of the recorder and presents information on the theory of humidity recording. Also lists information on equipment specifications. LEEDS & NORTHRUP Co., PHILADELPHIA, PA. 14

Motors. A standard-size, four-page bulletin, 21-121, giving information on the installation, care and adjustment of Century fractional horsepower single phase motors. Gives information on service operations to be performed before starting the motor for the first time, also the operations if the motor fails to start or if the operation of the motor is unsatisfactory. CENTURY ELECTRIC Co., ST. LOUIS, MO. 15

Portable Tools. A standard-size, 58-page catalog describing the complete line of Black & Decker portable tools and accessories. THE BLACK & DECKER MFG. Co., TOWSON, MD. 16

Pumps. A standard-size, four-page catalog illustrating and describing the Worthington deep well pump, types QE and QAE, which are designed for handling from 30 to 225 g.p.m. against heads up to 600 ft. WORTHINGTON PUMP CORP., HARRISON, N. J. 17

Stokers. A standard-size, 24-page bulletin, illustrating and describing the Detroit LoStoker. Catalog shows the details of construction, illustrates and describes automatic regulating devices which are used with the stoker, lists sizes and capacities, and gives a large number of diagrams and photographs of actual installations. DETROIT STOKER CO., DETROIT, MICH. 18

Unit Ventilators. A standard-size, 12-page bulletin, No. S340, describing the Trane unit ventilator. Catalog illustrates and describes the construction of the ventilator, tells how it operates, and shows a number of installations. THE TRANE CO., LA CROSSE, WIS. 19

Valve Reseaters. A small-size bulletin describing a set of tools which is designed to restore any valve to its full efficiency by tapping a thread into the old seat metal and screwing in a new removable seat. STANDARD RESEATER CORP., NEW YORK. 20

Welding. A 40-page book entitled "Cold Weather Care of Acetylene Generating and Distributing Equipment" giving information on the proper maintenance of acetylene generators subject to freezing. LINDE AIR PRODUCTS CO., NEW YORK. 21

Wrought Iron. A standard-size, wire-bound, 55-page general catalog of the A. M. Byers Company. This catalog provides complete mechanical information on Byers products such as welded wrought iron tubular, flat rolled and steel tubular products. The first pages of the catalog are devoted to a description of the properties of wrought iron and steel and to the method of specifying Byers wrought iron and steel products. In this section is listed the specifications of various societies, associations, and government departments for steel and iron products. Following this is a list of the technical publications available from the Engineering Service Department of Byers. The rest of the catalog is devoted to descriptions and data on the various Byers wrought iron and steel products. A complete index is also included. A. M. BYERS CO., PITTSBURGH, PA. 22

COMING EVENTS

FEBRUARY 23-25, 1939. Spring Meeting, American Society of Mechanical Engineers, St. Charles Hotel, New Orleans, La. C. E. Davies, Secretary, ASME, 29 West 39th St., New York.

MARCH 8-9, 1939. Conference on Air Conditioning, sponsored by the Department of Mechanical Engineering and the Engineering Experiment Station of the College of Engineering, University of Illinois. Prof. W. H. Severns, Chairman, General Committee, 103 Mechanical Engineering Laboratory, University of Illinois, Urbana, Ill.

MARCH 23-25, 1939. Second Oregon State Air Conditioning Conference, Oregon State College, Corvallis, Oreg. General Chairman, Prof. E. C. Willey, School of Engineering, Oregon State College, Corvallis, Oreg.

APRIL 28-29, 1939. Second Annual Anthracite Conference, Packard Memorial Hall, Lehigh University, Bethlehem, Pa. Chairman, Committee on Arrangements, Prof. Howard Eckfeldt, Lehigh University.

MAY 19-20, 1939. Second Coal Conference, sponsored by School of Engineering, Washington University, St. Louis, Mo.

MAY 22-23, 1939. 26th Spring Meeting, American Society of Refrigerating Engineers, Hotel Hershey, Hershey, Pa. ASRE Headquarters, 37 West 39th St., New York, David L. Fiske, Secretary.

MAY 24-26, 1939. Annual Convention, Association of Gas Appliance and Equipment Manufacturers, Hotel Roosevelt, New York. Association Headquarters, 60 East 42nd St., New York, C. W. Berghorn, Executive Secretary.

MAY 31-JUNE 2, 1939. 50th Annual Convention, Heating, Piping and Air Conditioning Contractors National Association, Drake Hotel, Chicago, Ill. Association headquarters, Room 1401, 1250 Sixth Ave., New York, Joseph C. Fitts, Secretary.

JUNE 5-8, 1939. National Association of Master Plumbers Convention, Minneapolis, Minn. E. L. Flentji, Executive Secretary, NAMP, 917 15th St., NW., Washington, D. C.

JUNE 13-16, 1939. 33rd Annual Convention of the Smoke Prevention Association, Hotel Schroeder, Milwaukee, Wis. An Exhibit of Fuel-Burning Equipment will be a feature. C. D. Behan, Publicity Director, SPA, City Hall Sq. Bldg., Chicago.

JUNE 27-30, 1939. 30th Annual Convention and Equipment Exhibit, National District Heating Association, Hotel Pennsylvania, New York. Wm. H. Sanford, Secretary-Treasurer, NDHA, 1317 Spruce St., Philadelphia, Pa.

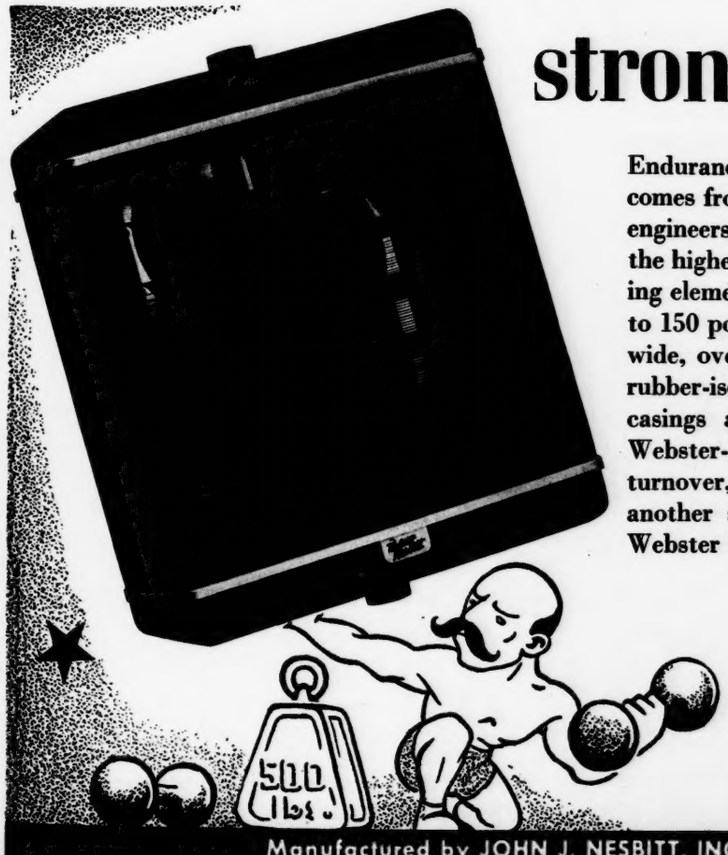
JULY 2-5, 1939. 45th Semi-Annual Meeting American Society of Heating and Ventilating Engineers, Grand Hotel, Mackinac Island, Mich.

OCTOBER 4-6, 1939. Exposition of Building, Industry and Services, Hotel Statler, Detroit, Mich. Sponsored by the Mortgage Bankers Association of America. George H. Patterson, Secretary-Treasurer, 111 West Washington St., Chicago, Ill.

OCTOBER 17-20, 1939. 68th Annual Meeting, American Public Health Association, William Penn Hotel, Pittsburgh, Pa. Dr. Reginald M. Atwater, Executive Secretary, APHA, 50 West 50th St., New York.

JANUARY 22-26, 1940. 46th Annual Meeting, American Society of Heating and Ventilating Engineers, Cleveland, Ohio. To be held in conjunction with the 6th International Heating and Ventilating Exposition at the Cleveland Public Hall.

JANUARY 23-25, 1940. 35th Annual Meeting, American Society of Refrigerating Engineers, Hotel Cleveland, Cleveland, Ohio.



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